School of Information Systems

Hospital Information Systems Implementation Framework: Critical Success Factors for Malaysian Public Hospitals

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature: ……………………………………………………

Date: 29 March 2013

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May Allah reward you all abundantly.

Dedication

To my loving family

Husband: Ahmad Afiza Jamaluddin

Children: Zyad, Adhwa, Zharif, Zharfan and Zahin

In loving memories

Father: Hj. Abdullah Salleh

With love and respect

Mother: Hjh. Amnah Abdul Hamid

Mother in law: Hjh. Rosni Abu Bakar

"Thank you so much for your endless love and prayers"

Abstract

The delivery of high quality health services is among the most important government policies in healthcare; it is demonstrated via the significant investment committed to expand the sector. In order to provide quality health services, Hospital Information Systems (HIS) development and adoption has to be initiated; though evidence has shown that implementing HIS is not easy. To ensure continuous successful implementation, the understanding and determination of HIS implementation factors has become a crucial consideration for health providers. This study, instigated to alleviate this problem, identified critical factors that influence HIS implementation and examined structured indicators to measure HIS implementation.

Based on the critical success factors (CSFs) and DeLone and McLean's Information Systems success model, the research study developed an implementation framework comprised of essential elements to guide HIS implementation. In the framework, the DeLone and McLean IS success measures were adapted and presented as a reflective second order factor to capture the multifaceted nature of success. A total of 500 questionnaires were distributed to six public hospitals in Malaysia and 213 were used for analysis. This reflects a high response rate of 42.6 percent. To evaluate the extent of success, the partial least squares (PLS) based structural equation modeling (SEM) approach was employed. The findings of the study revealed that the CSFs in Malaysia differ from studies in developed countries. Three out of seven success factors namely system selection, enterprise-wide communication and team composition proved to be significant. Key implementation factors such as top management support, business planning, project management and change management were found to be insignificant.

The study is among the few that have tested empirically an implementation framework in the Malaysian settings; as such, it contributes significantly to theoretical, methodological and practical aspects of research. Theoretically, it established a new classification of CSFs that could influence HIS implementation. This new categorization is a significant effort to provide a practical list of CSFs that allows practitioners to focus on key areas during system implementation.

Additionally, the study presents a new model that suggests links or correlations between the CSFs and how these factors should be implemented.

With regard to research methodology, the study collected data from Malaysian public hospitals having a Total Hospital Information System (THIS) implementation; the type of data is rare considering the complex procedures involved. Also, the quantitative approach employed is suitable to attest the effectiveness of the implementation model. This study also utilized the SEM component-based or PLS analysis for assessing the implementation model. At present, it is still uncommon to find HIS implementation studies that utilize PLS analysis in Malaysia.

In terms of a practical contribution, the study provides guidelines for managers in decision-making and planning future HIS implementation. The risks of failures for HIS implementation could be reduced as the study also proposed the approach on how the CSFs should be implemented. Most importantly, this study has established a model that could assists practitioners and researchers in understanding the implementation process of HIS, specifically for Malaysian public hospitals. Additionally, its contribution can be used in analogous domains such as information systems (IS), enterprise resource planning (ERP) and enterprise systems (ES).

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Glossary of Key Abbreviations

AVE	Average Variance Extracted
BHIS	Basic Health Information System
BP	Business Plan and Vision
BPM	Business Process Management
BPR	Business Process Reengineering
CM	Change Management and Culture Program
CSFs	Critical Success Factors
EC	Enterprise-wide Communication
ERP	Enterprise Resource Planning
ES	Enterprise Systems
HIS	Hospital Information Systems
HIT	Health Information Technology
ICT	Information and Communication Technology
IHIS	Intermediate Health Information System
II	Individual Impact
IQ	Information Quality
IS	Information Systems
IT	Information Technology
MOH	Ministry of Health
OI	Organizational Impact
PLS	Partial Least Squares
PM	Project Management
SEM	Structural Equation Modeling
SQ	System Quality
SS	System Selection and Technical Implementation
SvQ	Service Quality
TC	Team Composition
THIS	Total Hospital Information System
TM	Top Management and Project Championship

Glossary of Key Terms

Basic Health Information System (BHIS)	Comprises the Clinical Information Systems, Patient Management System and financials (Hassan 2004; Li 2010).
Critical Success Factors (CSFs)	Key areas when performed correctly, could assure success of an organization's HIS implementation (Holland and Light 1999; Parr, Shanks, and Darke 1999; Rockart 1979)
Hospital Information Systems (HIS)	Integrated information systems that manage hospitals' administrative, financial and medical information.
Intermediate Health Information System (IHIS)	Encompasses BHIS, Laboratory Information System (LIS) and Pharmacy Information System (PIS) (Hassan 2004; Li 2010).
Information Systems (IS)	"a system, whether automated or manual, that comprises people, machines, and/or methods organized to collect, process, transmit, and disseminate data that represent user information" (Institute for Telecommunication Sciences 2000, 1).
Total Hospital Information System (THIS)	Incorporates IHIS with Radiology Information System (RIS)/Picture Archiving and Communication System (PACS) and other applications (Hassan 2004; Li 2010).

Related Thesis Publications

Conference Papers

Abdullah, Z.S. 2010. "The Critical Success Factors of Business Process Management (BPM) System Implementation in Malaysian Hospitals." Paper presented at *Curtin Business School Doctoral Colloquium*, September 30 – October 01, 2010, Perth, Australia.

Abdullah, Z.S. 2010. "Discrepancy of Terminology in BPM System Implementation." Paper presented at *IADIS Internet Technologies and Societies (ITS 2010),* November 29 – December 01, 2010, Perth, Australia.

Abdullah, Z.S. 2012. "Hospital Information Systems Implementation: Testing a Structural Model." Paper presented at *2011 ICIDT International Conference on Information Science and Digital Content Technology*, June 26-28, 2012, Jeju, Korea.

Abdullah, Z.S., and M. Quaddus. 2012. "A Critical Success Factors Model for IS Implementation: Development and Validation of a Structural Model using PLS." Paper presented at *2012 ICCIT International Conference on Computer Sciences and Convergence Information Technology*, December 3-5, 2012, Seoul, Korea.

Chapter 1
Introduction

The important thing is not to stop questioning.
Albert Einstein (1879 – 1955)

1.1 Overview of the Thesis

For years, many industries have turned to information systems (IS) as a means of obtaining competitive edge; the health industry is no exception. In fact, improving health information systems is one of the prime agendas in most health reform activities throughout the world (Abraham, Nishihara, and Akiyama 2011; Buntin et al. 2011; Health Information and Management Systems Society 2008; Novak and Judah 2011). The goal of health information systems is to deliver efficient patient care and quality services (Haux 2004). Health information systems, otherwise known as health informatics, is a discipline that combines information science, computer science and healthcare study. It covers all aspects of healthcare, such as nursing, dentistry, hospital and other healthcare services. Hospital information systems (HIS) was chosen to limit the scope of the study; moreover, HIS as an instance of health information systems with the hospital as the healthcare environment (Haux 2006). As the name implies, this type of information systems was designed to manage hospital services like medical, administrative, financial and others.

HIS are known infamously to have an intricate structure and be subject to many implementation challenges (Haux 2006). In this regard, this thesis was designed to identify critical success factors (CSFs) that influence a successful implementation of HIS. Popularized by John F. Rockart of the Massachusetts Institute of Technology (MIT) Sloan School of Management in 1979, CSFs is a technique defined as the limited "areas of activity that should receive constant and careful attention from the management" (Rockart 1979, 85). No doubt, if there are too many factors being identified, the management loses focus or may even miss the most essential or critical factors that could lead to successful HIS implementation. In a typical organization, it is not uncommon to see that different management levels have different points of view on the required CSFs. Therefore, in this thesis the focus is on CSFs that affect the organization levels.

To determine the final CSFs in this study, a cross-sectional survey was conducted in Malaysian public hospitals. Malaysian public hospitals were selected mainly because most HIS implementation studies emphasize developed countries; namely, United States of America (USA), United Kingdom (UK), Germany and Australia (Dezdar and Sulaiman 2011b; Ngai, Law, and Wat 2008). Therefore, Malaysia, being a developing country, was selected as a suitable representative for identifying and determining the CSFs for HIS implementation. The success of the current HIS implementation was also ascertained as part of the survey. The results of the survey revealed that CSFs found in the developing country of Malaysia differ from those found in developed countries. The impact of the findings not only assists the hospital's management in Malaysia to strategize and prioritize its focus during the implementation of HIS projects but also serves as an eye-opener to the body of knowledge in the discipline. The rest of this chapter is dedicated to explain the research background, objectives and contribution of the study.

1.2 Research Background

Since the debut of the Health Information System discipline half a century ago, many studies have reported on Health Information Systems' implementation failures (Anderson 1997; Anderson and Aydin 1997, 2005; Berg 1999, 2001; Cline and Luiz 2013; Kaplan and Harris-Salamone 2009; Lorenzi and Riley 2000; Sharifi et al. 2013; Yasnoff Wa 2013). Despite the rapid growth of technology, successful implementation of Health Information Systems is still low. This explains why Health Information Systems has become

> "one of the brightest, most challenging and most promising fields of research, education and practice for medical informatics, with significant benefits and consequences for medical statistics and epidemiology, and to medicine and health care in general".
>
> (Haux 2006, 269)

The substantial disappointment following unsuccessful implementation is partly due to the complexity of the Health Information System itself (Grimson 2001). Furthermore, both people and organizational issues contribute to implementation failures (Berg 2001; Berg, Aarts, and van der Lei 2003; Lorenzi et al. 1997). Hence, in this study, the aim was to determine and examine the factors which may influence successful implementation. Although the term *Health Information Systems* is the label given to information systems in the entire healthcare domain and the term *Hospital Information Systems* focuses specifically on the information systems within hospitals, the scope and definition of *Hospital Information Systems* is seen as a subset of *Health Information Systems.* In the current thesis the term Hospital Information Systems is preferred, though some researchers use the terms interchangeably (Kuhn and Giuse 2001).

The health domain was chosen primarily because most developed countries such as the USA, UK and Australia have emphasized the growth of this industry (Commonwealth of Australia 2009; Timms 2010; U.S. Government Printing Office 2010). Seemingly, Malaysia shares the same aspiration, indicated by the emphasis in the recent Malaysian 2010 budget and in the Ninth Malaysia Plan, where the Malaysian government highlighted the expansion of public health facilities and the strengthening of the Information and Communication Technology (ICT) industry (Abdul Razak 2010; Parlimen Malaysia 2006).

To date, very few studies have attempted to understand the HIS implementation process (Aarts, Doorewaard, and Berg 2004). Mainly, this is due to difficulties in gaining access to hospital data. Moreover, a majority of implementation projects take a long time to complete; thereby straining research budgets. Hence, time and budget constraints provide essential justification for the lack of preference for this type of research. Other limitations include data confidentiality and employees extreme workloads. Consequently, the current study is among the few that have attempt to investigate empirically the hospital system implementation success factors in Malaysia.

1.2.1 Evaluation Framework

To achieve the objectives in this study to identify and investigate factors influencing successful HIS implementation, an implementation framework was developed. The purpose of the framework was to ensure that all main concepts, variables and relationships are well thought-out. Many past HIS implementation studies seem to have emphasized use of an evaluation framework as a feedback mechanism as important in order to improve and promote the usage of information systems. Evaluation assists the enhancement of future development where one learns from past mistakes. Furthermore, performing constructive evaluation from the development through to the implementation phase could maximize success and minimize implementation failures (Brender 2006).

There are two types of evaluation study; formative and summative evaluation. Formative evaluation is intended to improve the information systems during the development or implementation stages, whereas the summative evaluation is used as a final evaluation of the system in operation (Friedman and Wyatt 2000; Kaplan 1997). Also, evaluation can be performed throughout the entire project life cycle such as from the selection, procurement, implementation, testing and maintenance phases (Beynon-Davies, Owens, and Williams 2004). In the current study, the intention was to create an implementation framework which was a hybrid evaluation comprising of formative and summative evaluation. Both types of evaluation assist in understanding and can enhance future implementation strategies and development (Heathfield, Pitty, and Hanka 1998). Hence, an integrated evaluation method tends to make the next release of HIS better (Tuttle 1999).

According to Heathfield, Pitty, and Hanka (1998), evaluation studies are not helpful as they do not have the necessary details to inform decision-makers and they are too difficult to generalize. The researchers add that evaluation should not be merely for liability purposes but also for understanding purposes in order to improve HIS implementation. Given that some evaluation studies could cause harmful consequences due to an inappropriate approach and inaccurate interpretation of evaluation results, a better approach to improve HIS implementation is still desired. Addressing this gap has been the main motivation for this study.

1.2.2 A New Implementation Framework

The review of literature on HIS has indicated that the majority of prior studies has attempted to develop summative evaluation frameworks rather than implementation frameworks (Ammenwerth et al. 2004; van der Meijden et al. 2003; Yusof, Papazafeiropoulou, et al. 2008). Ammenwerth et al. (2004), van der Meijden et al. (2003) and Yusof, Papazafeiropoulou, et al. (2008) advocate that by assessing an existing system, the factors leading to successful implementation could be found. Nonetheless, it is more important to have all the necessary constituents leading to implementation success prior to evaluation. Therefore, in this study a HIS implementation framework was developed to expose the essential implementation factors that may influence the success of HIS implementation.

The implementation framework was designed from the success factors found in the literature. However, the study not only covered literature from the HIS area but also other analogous areas such as the general information systems (IS) domain, the enterprise resource planning (ERP) domain, and enterprise systems (ES) domain. A synthesis of all the success factors was performed to capture as many success factors as possible that are relevant to HIS implementation. The IS domain was chosen primarily because HIS originates from the IS discipline. On the other hand, the ERP domain was selected as some HIS are ERP systems (Botta-Genoulaz and Millet 2006; van Merode, Groothuis, and Hasman 2004). The difference between ERP system and ES is apparent. ERP systems "are configurable information systems (IS) packages that integrate information and information-based processes within and across functional areas in an organization" (Kumar and Van Hillegersberg 2000, 23) whereas ES integrates the heterogeneous ERP systems together (Davenport 2000a; Giachetti 2004; NickMutt.com 2010). In other words, ES has a broader scope than ERP. In this study, it was acknowledged that all these domains are analogous to the HIS domain.

The main elements of the implementation framework are the candidate success factors and the success measurements. Moderating variables such as gender, age, technology experience, project role, job position and education level are also included in the implementation framework as they are recognized as likely to cause a contingent effect on the relationships between the independent variables and the dependent variable (Chin, Marcolin, and Newsted 2003). They can either strengthen or weaken the relationships, causing variations of studies outcomes. A detailed explanation of the theoretical framework has been provided in Chapter 3 of this thesis.

1.2.3 Candidate Factors for Successful Implementation

In regard to HIS implementation success factors, numerous HIS studies have sought to identify factors related to HIS implementation successes and failures, among others (Ammenwerth, Iller, et al. 2003; Hung et al. 2010; Kaplan and Harris-Salamone 2009; Prijatelj 1999; Vagelatos and Sarivougioukas 2001). The importance of these factors cannot be ignored as they guide practitioners and researchers to focus on key areas during implementation. In this study, the critical success factors methodology was used to identify the relevant factors for successful implementation.

Critical success factors (CSFs) are key areas that, when performed correctly, could assure success of an organization's HIS implementation (Holland and Light 1999; Parr, Shanks, and Darke 1999; Rockart 1979). This is also affirmed by Mobey and Parker (2002); viz., that understanding the CSFs could increase the chances of a project's success. Many IS studies have used this approach especially in the ERP research domain (Finney and Corbett 2007; Nah, Lau, and Kuang 2001; Nah, Zuckweiler, and Lau 2003; Somers and Nelson 2001, 2004). Thus, the CSFs identified in this thesis are derived from the organizational, technological, socio-technical and project standpoints. The main strengths of the CSFs approach are that it is readily understood by senior managers and that it facilitates the planning process (Boynton and Zmud 1984).

Some researchers have observed that the factors research[1] approach has little practicality in coping with IS problems (Markus and Robey 1988; Newman and Robey 1992); the approach emphasizes the factors and their associated outcomes without much information to structure or implement them (Barki and Hartwick 1994; Newman and Zhao 2008; Robey 1994). Also, it seems that most prior studies have discussed and identified factors only for successes and failures and the effect of these implementation factors are rarely tested (Hwang and Xu 2007). Similarly, prior studies tend to list the implementation factors without giving any empirical evidence to support their findings. Therefore, in this study the attempt is to overcome this limitation by conducting an empirical study that tests the effects of the implementation factors. The study not only adapts the factors research approach, but also combines it with the DeLone and McLean IS success measurements to further examine and evaluate whether the implementation factors influence success or otherwise.

The study not only identifies the success factors that could influence HIS successes but also determines the interrelationships of the CSFs. Prior studies on CSFs relationships have failed to validate their CSFs interrelation model (Akkermans and van Helden 2002). Thus, in the current study, the interrelations among the success factors are examined using partial least squares (PLS) path coefficient analyses which can provide more accurate estimates (Chin, Marcolin, and Newsted 2003). The results from the findings assist in determining whether or not the factors must coexist. With this information, the management can plan effectively for future HIS implementation.

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[1] Factors research is discussed in detail in Section 2.2.2. It is a type of IS implementation approach.

1.3 Research Questions and Objectives

Although there have been several research studies on HIS in Malaysia, none has specifically looked at aspects of the system implementation. The need to address this gap in the literature is important especially given that research in other parts of the world have identified that there are more failures than successes in system implementation (Berg 2001; Cline and Luiz 2013; Giuse and Kuhn 2003; Lorenzi and Riley 2003; Monem et al. 2011; Sharifi et al. 2013; Yasnoff Wa 2013). In its course to become a developed nation by 2020, Malaysia needs to enhance its hospital services through the use of information technology. Motivated by this concern, the intention of the researcher was to develop a framework for a successful HIS implementation.

Based on the need to understand CSFs that could influence successful HIS implementation in Malaysian public hospitals, the major research question in the study is formulated as follows:

What are the critical success factors (CSFs) that influence HIS implementation in Malaysia's public hospitals?

A successful implementation is essential for competitive and economic advantages but, unfortunately, not enough is understood about the implementation process (Linton 2002). To answer the research question, it is important to gain a better understanding of the implementation process and the factors influencing the success or failure of HIS. Consequently, three supporting research questions were developed to facilitate the investigation. They are:

1. How do the CSFs interrelate with each other?
2. How and to what extent do CSFs influence HIS implementation?
3. What are the effects of moderating variables to HIS implementation framework?

Based on the research questions, the following research objectives were developed:

1. identify critical factors influencing the success of HIS implementation;
2. investigate how the CSFs interrelate;
3. determine the influence of the CSFs on HIS implementation; and
4. examine the effects of moderating variables namely gender, age, technical experience, project role, job position and education level.

The first objective identifies the critical factors that influence successful implementation. The success factors may emanate from the organizational, technological, socio-technical, and project perspectives. Identifying these factors assists management to focus on key target areas for achieving success.

The second objective is to understand the relationships between the success factors. This information is useful to extend prior studies that have provided only a list of success factors without understanding the relationships between the factors. With this knowledge, management has better insight and is able to strategize on how best to implement these success factors.

Against the factors identified in objective one, the third objective determines the current HIS implementations in Malaysian public tertiary hospitals. By assessing HIS implementation, the strengths and weaknesses of the current implementation can be identified and ways to improve the implementation can be suggested. With this knowledge, the management is able to strategize future HIS implementation projects.

The fourth objective is to ensure that the results of the study are not affected by moderating variables. The moderating variables examined in this thesis are gender, age, technical experience, project role, job position and education level; they are known to provide superfluous effects. If it is proven that there are significant effects, then the managers can better control and influence the effects of the moderating variables. Research objectives can be converted into research questions and vice versa. The research questions in this study are discussed further in Chapter 7.

1.4 Significance of the Study

The study makes a significant contribution to theory and methodology, for the benefit of researchers and practitioners. Theoretically, it will establish a new classification of CSFs that may influence HIS implementation. The development of a new categorization is a significant effort to provide a practical list of CSFs that allows practitioners to focus on key areas during system implementation. Additionally, the study will result in a new implementation framework that suggests links or correlations between the CSFs and how these factors should be implemented.

In the past, most studies merely provide a static number of factors; a factor set which is insufficient for one to acknowledge as an explanation for system outcomes. Prior studies have examined only either implementation success factors or information systems success independently. In trying to contribute to the literature, the research framework in the current study has taken into account both sets of variables; the implementation success factors and the IS success dimensions; this allows for the influence of the success factors to be tested. The novel framework also addresses the gap that exists between HIS implementation and the integration of theories by incorporating the DeLone and McLean IS success theory. This assists in understanding the multidimensional aspects of HIS success. In other words, the current study extends the dimensions of IS success within the healthcare context and contributes to the limited literature for developing countries.

HIS implementation differs significantly from other domains[2]. It is important to understand the HIS implementation process because many HIS implementation projects today are still unsuccessful (Ash 2003; Berg 2001; Kaplan and Harris-Salamone 2009). To exacerbate the matter, not many information systems' implementation studies focus on hospital system implementation due to the difficulty

[2] Explanation on domains is furnished in Section 1.2.2.

of obtaining the data. The intention in the current study is to add new information to the body of knowledge, specifically in the HIS implementation domain; i.e., by combining IS theories into the implementation framework in order to gain a better understanding of the HIS implementation process.

Methodologically, the study also has made an important contribution to empirical research. It is imperative to note that there is a shortage of quantitative research in determining the implementation factors for HIS. Many prior research studies on system implementation are dominated by qualitative and single-site studies. Moreover, the qualitative approach is preferred in understanding the implementation process (Hwang and Xu 2007; Markus 1983). For example, Sumner (1999) presented her CSFs findings based on four case studies. In another study, Bingi, Sharma, and Godla (1999) identified CSFs from a literature review where no empirical testing was conducted. Nah, Lau, and Kuang (2001) reviewed CSFs from 10 articles and did not state whether empirical research, case studies or other methods determined the factors. For these reasons, in the current study the quantitative research approach was employed to determine the CSFs relative to HIS implementation; also, the quantitative approach was used to attest to the effectiveness of the research framework. Consequently, it is argued that the study has demonstrated its achievement in filling the void of quantitative research, and by providing an approach that was able to answer the main research question.

Even though implementation factors have been discussed in many past studies, the effect of those factors rarely has been tested in empirical research. In order to bridge the gap, empirical data from six public hospitals that have implemented Total Hospital Information System (THIS) in Malaysia were collected in the current study by means of a cross-sectional survey. Subsequently, after reclassifying the success factors, the collected data was tested to confirm the implementation factors. Also, the data were examined to determine the extent of THIS implementation success. Another contribution of the current study is that it utilized the component-based structural equation modeling also known as partial least squares (PLS) analyses for assessing the research framework. At present, it is still uncommon to find HIS implementation studies that employ PLS in Malaysia. Therefore, by applying PLS evaluation, the study has provided another vital methodological contribution to the body of knowledge.

The advantage in identifying and acknowledging the right key success factors is no less crucial than the knowledge, skill and ability to conclude a HIS implementation. By accurately identifying the factors, the probability for future HIS implementation to be successful can be enhanced. This is justified via the practical contribution of the study where CSFs can serve as a planning tool for future HIS implementation. The CSFs can assist in *operational planning* for determining the required activities to implement HIS; *strategic planning* for ensuring the expansion of information technology is consistent with the corporate strategy; and *policy planning* for establishing the organizational culture in order to promote HIS usage (Boynton and Zmud 1984). The risks associated with HIS implementation failures can also be reduced since the study proposes an approach on how the CSFs should be implemented. In summary, the study has established that CSFs facilitates the making of better decisions by senior managers and IT managers.

For both practitioners and researchers, the outcomes of the study can be used to aspire to a standard guideline for HIS implementation. The standard guideline can assist practitioners and researchers to employ readily available instructions or rules for HIS implementation and to help researchers to compare HIS implementation across a range of professions in the health industry. Comparison studies are important in order to gain insights into the implementation process. At present, there are various approaches to assess HIS implementation success. A standard approach makes the theory and practice of HIS implementation more valid and reliable. The findings in the current study contribute significantly to the healthcare sector specifically, and the policy-makers in Malaysia generally.

1.5 Research Approach

This thesis follows the positivist research paradigm. The quantitative research approach is applicable for research problems that seek to identify factors that influence an outcome, to understand the best predictors of outcomes and to test theories or explanation (Creswell 2009). As the main intention in the study was to identify factors that may influence system implementation success, the quantitative approach was deemed the most appropriate. The research design begins from the literature review where success factors are gathered and synthesized to develop the survey instrument which includes plausible success factors and measurements for assessing success. Accordingly, in the analysis phase, the structural equation modeling (SEM) partial least squares (PLS) technique is employed to assess the HIS implementation framework (Chin 1998a; Chin, Marcolin, and Newsted 2003).

1.6 Summary and Thesis Structure

In this chapter, the background of the study has been introduced and the initial approach to the research area. The thesis developed from the study is presented in seven chapters. **Chapter 1** provides an overview of the entire study and introduces the research area; this includes defining the research objectives, contributions and approach.

Chapter 2 presents a comprehensive review of the literature in the research area. In particular, the chapter contains discussion of IS implementation studies, describes HIS and its implementation, examines the critical success factors (CSFs) of system implementation, justifies the chosen theories and clarifies the standing of HIS implementation in Malaysian public tertiary hospitals.

Chapter 3 illustrates the theoretical background of the conceptual framework. CSFs and IS success theories are amalgamated to explore their potential for improving previous frameworks related to HIS implementation. The theoretical background provides the basis for the collection of research data and the development of a proposed HIS implementation framework.

Chapter 4 explains the research design and methodology in which a quantitative research approach is employed in order to accomplish the research objectives. The chapter clarifies the quantitative research design, questionnaire instrument development and describes the activities for data analysis and the necessary statistical technique used during analysis. In effect, the chapter is used to summarize the research process used in the study.

Chapter 5 presents the quantitative findings from the questionnaire. Construct validity, content validity, reliability test and various statistical tests such as correlation and PLS assessments are illustrated in the chapter. Here, also, is where, the hypotheses of the thesis are verified.

Chapter 6 is used to discuss the outcomes of the thesis and their implications. The findings reveal that only three out of seven factors are relevant for HIS success. However, these results cannot be generalized for all Malaysian public hospitals because there are many types of HIS implementation and the current study covers only the Total Hospital Information System (THIS) implementation.

Chapter 7 contains the summary and conclusions of the thesis, addresses a number of limitations, highlights the contributions to the field of research and makes suggestions for future research.

Chapter 2

Literature Review

Your most unhappy customers are your greatest source of learning.
Bill Gates (1955 – current)

2.1 Introduction

Much has been written and said about information systems implementation. Literature suggests that various implementation factors such as top management support and effective project management play critical roles in determining the success of an information system (Akkermans and van Helden 2002; Dezdar and Sulaiman 2009; Finney and Corbett 2007). Yet, to date, many implementation projects are still unsuccessful (Anderson and Aydin 2005; Berg 2001; Kaplan and Harris-Salamone 2009; Lorenzi and Riley 2000). This has been the main motivation for the current study. Particularly in Malaysia, the lack of HIS implementation empirical research is another impetus for selecting the hospital domain.

In determining the factors for a successful implementation, much literature advocates that the people factor is the core component for success and should not be ignored (Berg 2001; Berg, Aarts, and van der Lei 2003). Numerous studies reported that implementation failures occur when the focus is entirely on the technical aspects of the change (Davis and Bostrom 1993; Gery 1997; Prijatelj 1999). Others claim that technology should not be considered as the driver for successful implementation but as the enabler or catalyst for success to occur (Ball, Peterson, and Douglas 1999; Lorenzi and Riley 2000; Prijatelj 1999). Nonetheless, many agree that successful implementation requires a good and effective combination of technical and organizational skills (Lorenzi and Riley 2000). All these claims are constructive and beneficial, and have been considered for the implementation framework.

This chapter is developed to discuss, compare, contrast, criticize and synthesize the extant literature related to the research topic. Gaps and problems are addressed and ways of overcoming these issues are discussed. The chapter begins with a discussion of the IS discipline which is the essence of HIS and also studies relating to IS implementation. Notwithstanding, it is also important to recognize theories that are applicable to the research questions. The following section is directed at examining specific IS theories and why these theories are considered relevant for attaining the research objectives. This is followed by the section on HIS implementation literature. In the remaining section Malaysia's HIS implementation is discussed. Table 2.1 depicts the organization of the literature review undertaken.

Table 2.1: Summary of Literature Review

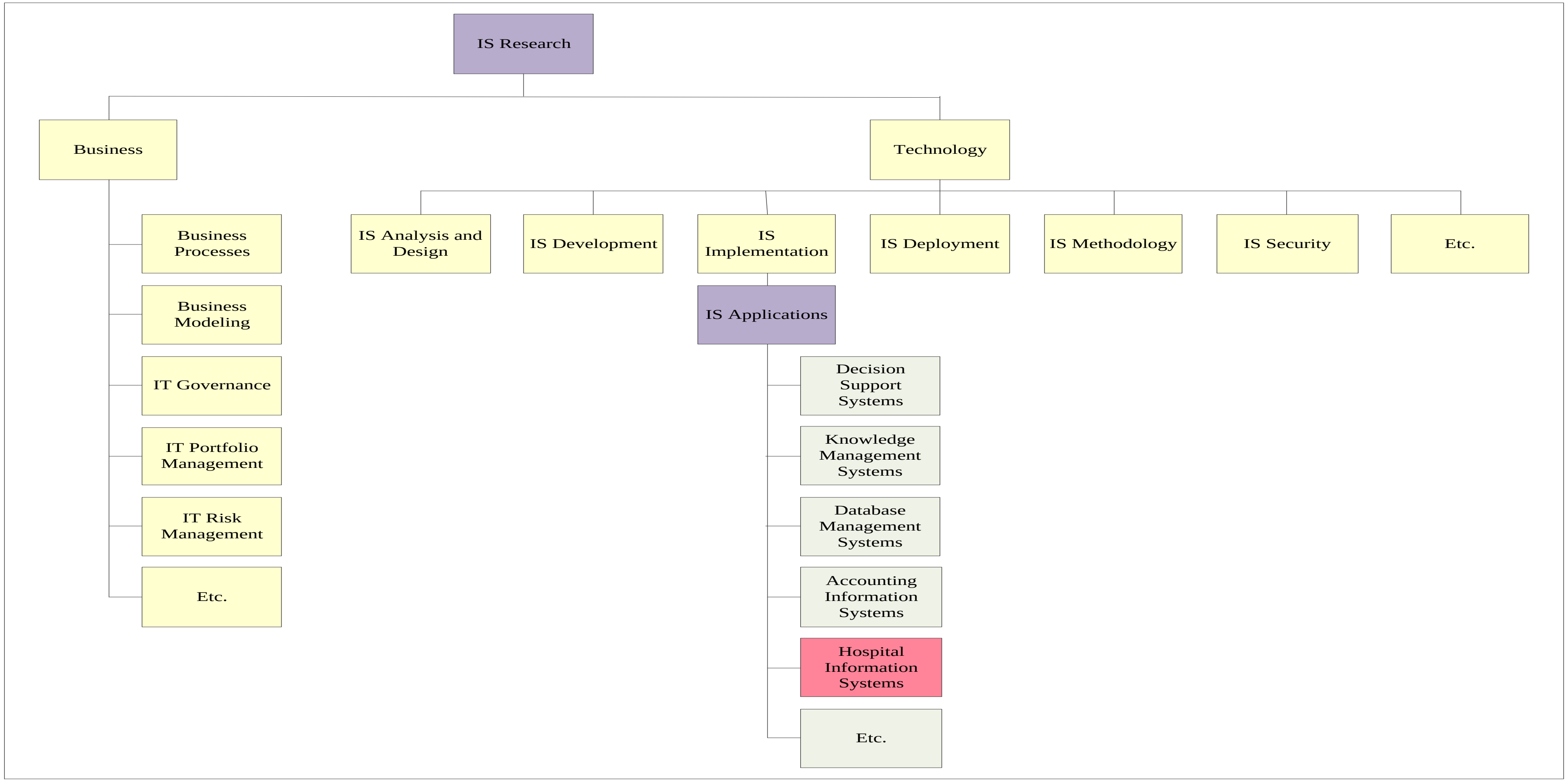
Thesis Phase	Thesis Chapters	Literature Reviewed
Design phase	Chapter 2: Literature Review	The entire chapter provides a holistic view of the area under investigation. The main areas discussed are: Information Systems (IS), IS evaluation, IS implementation, IS theories, Hospital Information Systems (HIS), HIS evaluation, HIS implementation and Malaysia's HIS implementation.
	Chapter 3: Theoretical Framework and Hypotheses	Section 3.2 presents the relevant literature for deriving the dependent variable; i.e., the success dimensions. Section 3.3 gives a review that identifies the list of critical success factors (CSFs) as the independent variables [exogenous constructs] for the framework. It also discusses the process of selecting the candidate success factors and re-classifying to offer a comprehensive model for the framework.
Development Phase	Chapter 4: Research Approach	Section 4.2 supplies a comprehensive review of the epistemology of the thesis. Different philosophical views are discussed along with the justification for the quantitative method. Section 4.3 furnishes the literature for the quantitative research methodology. Justifications are given for favoring the survey research over the experimental research. Section 4.4 offers a summarized literature for the various data collection method. Section 4.6 delivers a detailed review of the research design from the unit of analysis up to the analysis procedure.
Testing phase	Chapter 5: Data Analysis and Results	Pertinent literature for the chosen statistical techniques is discussed in this chapter.

2.2 Information Systems

Information Technology (IT) has become the cutting edge of global competition. Companies and organizations are keen to invest in information technology due to its potentials as a strategic enabling tool to support growth and enhance quality. IT is the area that manages technology which typically comprises of computer science, information systems, computer hardware, software, programming languages, network and many more. Conversely, Information Systems (IS) is a discipline that unites the business and computer science domain. Silver, Markus, and Beath (1995, 362) defines that "information systems are implemented within an organization for the purpose of improving the effectiveness and efficiency of that organization". Hence, the blend between people, organization and technology is the major concern in IS. Despite the differences between IT and IS, in most literature, these two terms are used interchangeably (Lee 2004). In this study, IS and IT are treated alike.

There is an abundance of IS domain literature merging between the business and technology realms. The business realm covers researchers in relation to business processes, business modeling, IT governance, IT management and others. The technology domain on the other hand, encompasses areas from IS development to IS deployment. IS research studies also vary according to applications such as decision support systems, knowledge management systems, database management systems, accounting information systems, manufacturing information systems, health information systems, transaction processing systems and many more. Other areas of IS studies include research on methodology, analysis and design, and security. Figure 2.1 illustrates the diverse research areas in the IS domain.

Figure 2.1: IS Research



Source: Adapted from Chiasson and Davidson (2005); Claver, González, and Llopis (2000); MIT Sloan (2012); Walsham and Sahay (2006).

Each IS research area has its own followers or research groups that sometimes intersect with other domains. This makes it difficult to streamline the areas of research in IS. The current study was devised to focus only on IS implementation, particularly for the health domain. In the next section, IS evaluation, implementation and theories are considered. It is imperative to reiterate that, in the study, the main intention was to find factors affecting successful HIS implementation. Thus, in order to check the extent of success or failures of system implementation, the issue of evaluation came into the picture.

2.2.1 Information Systems Evaluation

Evaluation research is a discipline that serves numerous purposes such as assessing system performance, system usability, data and system quality, returns of investment and many more. Willcocks (1992, 245) describes evaluation as "establishing by quantitative and/or quality means the worth of information technology (IT) to the organization". Evaluation research has extended its applications progressively into other fields, and IS evaluation is one of them; its main functions being to improve and to guide future developments in IS. Also, it is a technique used to evaluate IS effectiveness. In this thesis, evaluation is used to determine the extent of success in system implementation. Nonetheless, to assess and to proclaim whether a system implementation is successful or not remains quite subjective.

Evaluating a system's implementation is definitely not a straightforward task that is free from any complication. There are factors and aspects that seriously need to be reflected on when performing the evaluation process. Among the difficulties of evaluating system implementation are: *whose* perspectives should be used to consider whether the system is successfully implemented?; *when* must the evaluation be performed (e.g., prior the implementation, during implementation or after the implementation)?; *how* should the system implementation be evaluated (or what methods must be used for evaluation)?; and *what* ought to be evaluated (the system, the users, or both system and users) in order to suggest that the implementation is successful? Hence, evaluation is meant to provide "detailed answers to the question of *why* and IS initiative works better for *whom* and in *what* circumstances" (Carlsson 2003, 16).

As indicated in Section 1.2.1, there are two views of evaluation: formative and summative evaluation. The former provides on-going information throughout the system implementation process whereas the latter determines the system implementation final outcomes (Hamilton and Chervany 1981). However, Scriven (1996) disagrees with the notion that formative evaluation is a kind of process evaluation and summative is associated with outcome evaluation. Scriven argues the distinction between formative and summative evaluation is actually context dependent; for instance, realizing the failure of a system implementation project is summative for the management, but formative for the implementers. In addition, a summative evaluation can actually be used for both process and outcome evaluations. Using the same example of implementation failure, it is suggested that future implementers can make an effort to improve the implementation process by employing the results of the summative evaluation. Also, sometimes due to budget or time constraint, only the formative evaluation is performed. The results of the formative evaluation can serve then as a summative evaluation (Scriven 1996).

Wiliam and Black (1996) have a different perspective on formative evaluation. They explain that all assessments have the possibility to function as summative evaluation but only some can serve as formative evaluation. Formative evaluation must indicate that there is a disparity between the actual and desired levels of performance and suggest ways to amend this occurrence. Thus, interpretations or results from formative evaluation "form the basis for successful action in improving performance" whereas summative evaluation ensures consistency of the interpretations (Wiliam and Black 1996, 544). To phrase it differently, without explicit evidence that the performance is undesirable, then it is merely a summative evaluation.

From an education perspective, Bloom (1971) defines summative evaluation as those assessments given at the end of a program or project to assess its effectiveness and formative evaluation as assessments on everyone involved throughout the project in order to improve. Viewing all these different definitions for formative and summative evaluation, in the current study formative evaluation was regarded as improving the information systems during development or implementation whereas summative evaluation relates to the system already in operation (Friedman and Wyatt 2000; Kaplan 1997). The main reason for the adoption of this definition is because most evaluation researchers suggest formative is an ongoing evaluation that can be used to improve the situation, whereas summative is used at the end of the project so that results can be compared against a certain benchmark. In future, information from the summative evaluation can be applied formatively in successive projects.

In many organizations there is a belief that IT brings competitive advantages; but, it is also the case that, often the management cannot prove the truth of their argument. In order to justify the massive investments required in IT, early work in evaluation research focused on the worth of IT investments (Willcocks 1992). Progressively, evaluation research began to branch out to other areas of IS. For example, Kushniruk (2002) uses formative evaluation to evaluate the design of health information systems. In his study, Kushniruk demonstrates usability testing as the main method to evaluate the design of the system. On the other hand, Yusof, Papazafeiropoulou, et al. (2008) apply summative evaluation to assess factors influencing system adoption. Their findings revealed that if users have the right attitude, skill and communication, system adoption is more likely to be successful.

According to Beynon-Davies, Owens, and Williams (2004), the most frequently evaluated criteria in IS research are functionality, usability, quality (i.e., system, data, and service quality) and facilitating criteria (i.e., user satisfaction, ease of use, and usefulness). Even though there are evaluation studies on the socio-technical criteria (i.e., impact on the user and organization), the research is quite limited in number (Beynon-Davies, Owens, and Williams 2004). Therefore, this study was developed to include the socio-technical measures in the conceptual framework.

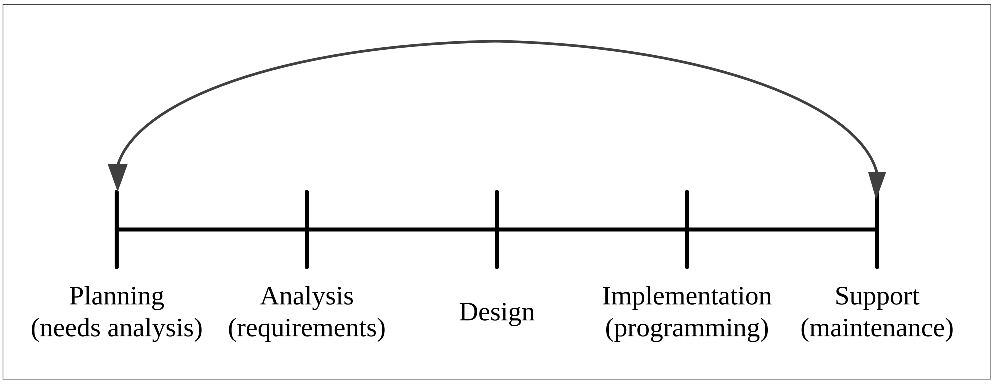
To sum up, it is important to conduct IS evaluation since it relates to the issues of IS success and failure. Evaluation helps one identify the weaknesses of the current system in the organization and elicits ideas on ways to overcome limitations.

Nonetheless, contrary to most belief on evaluations, Kumar (1990) claims that many organizations have performed evaluation as an act of formalization to signify the completion of a project. As a result, the benefits of evaluation are not fully realized by this kind of evaluation. Thus, in the current study, Scriven's (1996) evaluation concept was used to ensure that future IS implementation could prosper.

2.2.2 Information Systems Implementation

The field of evaluation is extensive and encompasses many IS areas and processes. Therefore, evaluation can occur throughout the life cycle of an IS project from selection, procurement, implementation, testing and maintenance (Beynon-Davies, Owens, and Williams 2004). Although there are attempts in a number of research studies to build a generic framework that integrates evaluation and IS project life cycle, to date, none have shown empirical evidence that their framework actually works (Beynon-Davies, Owens, and Williams 2004). Studies that strive to provide empirical evidence have chosen a safer approach by selecting only one part of the IS project life cycle and the scarcity of a framework that links evaluation across the entire IS life cycle has been noted.

Figure 2.2: The Systems Development Life Cycle (SDLC) in Relation to Evaluation Methodologies



Source: Adapted from Kushniruk (2002).

On the other hand, Kushniruk (2002) asserts that evaluation spans a continuum from systems planning to support (refer Figure 2.2). Prior to any IS implementation, it is best to perform assessments on user needs and systems requirements (Kushniruk 2002). In his own evaluation study, Kushniruk utilizes the design phase to assess the usability of health information systems. In another study, Nurmi, Hallikainen, and Rossi (2011) discover that evaluation is not performed in the early stages of system development. They propose new concepts to ensure evaluation is carried out especially in the requirements analysis and design phases. A recent study by McCabe et al. (2012), evaluates system quality in the design and implementation phases so as to facilitate continuous quality improvement. These are some examples where an evaluation study is conducted at different points of the SDLC life cycle.

In this study, focus has been placed on the implementation stage. Even though the field of IS implementation has been investigated for more than 50 years, the progress of understanding IS implementation is still inadequate (Peng and Kurnia 2010; Robey, Ross, and Boudreau 2002). Thus, the intention in the study is to provide empirical evidence for the implementation framework; besides, to build, test and analyze a comprehensive framework that covers all aspects of the information systems life cycle is beyond the capability of a single researcher.

Focusing only on one part of the IS life cycle appears straightforward. However, this area of research has numerous problems, mostly due to the fragmented literature on IS implementation; inconsistent definitions of IS implementation and the lack of paradigm for IS implementation research efforts (Kwon and Zmud 1987). Even though Kwon and Zmud’s findings are more than 20 years old, they are valid still due to the vast areas of IS to which they can be applied. Kwon and Zmud went on to classify IS implementation literature into five research groupings; namely, mutual understanding research, political research, prescriptive research, process research and factors research.

Mutual understanding research focuses on the interactions and information exchange between the designers and users of a system. Basically this type of research suggests that a positive relationship between the developers and the users increases the chance of implementation success. This research type was most popular during the 1980s and 1990s when much study focused on investigating user involvement during the implementation process (Amoako-Gyampah and White 1993; Baroudi, Olson, and Ives 1986; Ives and Olson 1984; Torkzadeh and Doll 1994). The expansion of this branch of research has been somewhat limited due to theoretical and methodological issues (Kwon and Zmud 1987).

On the other hand, political research addresses the various stakeholders' interests in IS implementation. Kwon and Zmud (1987) consider that successful implementation depends on how these diverse interests are addressed and managed. Studies in this area vary from the perspective of users, key users, managers and other stakeholders (McGinn et al. 2011). It can be presumed that different groups of users will have contrasting interests and expectations, and that diverse interests can also vary between departments, organizations and countries. The major drawback of this research is that it would be difficult to create a generic framework or research model that can be useful for the IS domain due to the extensive nature of the subject matter.

Alternatively, prescriptive research focuses on identifying factors relating to implementation risks. Risk can be defined as potential problems that hinder IS implementation success (Sumner 2000). The main intention in this type of research is to formulate strategies on how organizations should overcome or resolve risks. In spite of that, this area of study seems to overlap with other implementation research; namely, factors research. Albeit prescriptive research emphasizes the risk factors and the factors research focuses on underlying reasons affecting the success and failure of the IS implementation, the results from both research groups appear to be somewhat the same; this is despite the fact that both parties adopted different approaches in managing the results. For example, in prescriptive research, lack of user training is a risk in implementation. For factor research, training becomes one of the factors used to achieve successful implementation.

Process research focuses on social change activities and uses many organizational change theories (Cooper and Zmud 1990; Kwon and Zmud 1987). The goal of process research is to understand the overall implementation process so it can be effectively managed. This research type views the implementation effort as having a sequence of events or stages. However, the number of stages varies across studies (see Table 2.2) resulting in inconsistent definitions for the implementation stages (Kumar, Maheshwari, and Kumar 2002). The common stages of implementation include planning, implementation, stabilization and maintaining (Robey, Ross, and Boudreau 2002). Supposedly, process research is more thorough and complete compared to the others because it covers every aspect of the implementation process (i.e., from planning until post-implementation stage). Due to the complexity of evaluating and inspecting all stages of implementation as well as the un-standardized number of stages, the area of research remains limited.

Table 2.2: Process Research Stages

Authors	Implementation Stages
Rogers (1995)	Adoption and Implementation.
Cooper and Zmud (1990)	Initiation, Adoption, Adaptation, Acceptance, Routinization and Infusion.
Soh and Markus (1995)	IT Expenditure (Adoption), IT Assets (Implementation), IT Impacts (Post-implementation).
Markus and Tanis (2000)	Project Chartering, Project Configuration, Shakedown, Onwards and Upwards.
Robey, Ross, and Boudreau (2002)	Planning, Implementation, Stabilization, and Maintaining.

Source: Adapted from Kumar, Maheshwari, and Kumar (2002).

Factors research seems to have the largest number of followers; its emphasis is on identifying individual, organizational, technological, socio-technical and project factors relating to IS implementation successes and failures. The common identified factors are top management support, project management and change management (Dezdar and Sulaiman 2009; Finney and Corbett 2007; Nah, Islam, and Tan 2007). Ideally, if these factors are backed by the management then, most likely, the IS implementation will be successful. Although the findings from this type of research are reasonably consistent, most of the studies have been undertaken in developed countries and are no longer current (Peng and Kurnia 2010).

Among the five IS implementation research groupings, factors research seems to be the most suitable one to use in order to realize the objectives of this study. The main challenge with factors research is to determine the definition of IS successes and failures, which varies depending on perspective, time and location (Berg 2001; DeLone and McLean 1992). Therefore, it is important from the onset of the study that success is clearly defined so that it can be used as a guide throughout the research. Section 3.2 of Chapter 3 is used to deliberate more about the IS success definition employed in the current study.

Despite being the most popular approach, factors research has been subject to several criticisms. Heeks (2002) highlights that first, it does not inform *how* the implementation factors should be implemented; second, *what* establishes a successful implementation, differ across studies; and third, success can be further divided into total success or partial success. Thus, it is challenging to determine factors for successful implementation and, in addition, factors research merely lists the factors, whereas, in reality, the factors overlap and there are relationships between them (Cooke-Davies 2002; Fortune and White 2006; Pinto and Slevin 1989). Robey, Ross, and Boudreau (2002) add that past research did not explain how the list of CSFs affect the organization and that many lack a theoretical framework that can clarify the occurrence of the business outcome with or without the CSFs.

In order to confront some of the criticisms mentioned above, the study has been used to analyze interrelationships among the implementation factors. The chances of having a successful implementation can be maximized by understanding these relationships comprehensively. Should certain factors be found to be interrelated and must co-exist, then, these factors must be implemented simultaneously. For instance, to have a practical implementation team with balanced business and technical skill, there must be effective project management able to coordinate and structure the team composition. Examining and addressing the interrelationship of factors research gap indirectly fulfills the research objectives.

Despite the abundance of IS implementation framework research, not much research has been done in developing countries. There are possibilities that the common implementation factors found in developed countries are not relevant in developing nations. The current study, then, is an attempt to apply and explore factors research in developing countries; specifically, in Malaysia. To further understand the implementation process, a theoretical framework is developed. The framework combines some known IS theories that are deemed appropriate for this study. The objective in developing a framework is to help explain the investigated factors and the implementation outcomes. It is envisaged that the framework is able to provide insights to the implementation process.

Nowadays, the trend in most countries is to promote IT as an enabler for optimized national health services. Developed countries such as Australia, Canada, Germany, UK and the USA have supported this notion since the early 1990s. Australia for example, established the National Health Information Agreement in 1993 to ensure that technology is used to improve the quality of healthcare (The Boston Consulting Group 2004). Canadians on the other hand, have had their Canada Health Infoway accessible to the public since 2010 (Webster 2011). Germany implemented its national health information technology in 1993 (Anderson et al. 2006). The UK National Health Service (NHS) prioritized its health automation in 1998. In 2009, US President Obama signed the Health Information Technology and Clinical Health Act (HITECH) as part of the American recovery and Reinvestment Act (Steinbrook 2009).

Recognizing the importance of healthcare to governments and individuals has led to the emergence of healthcare as a significant area of research (Fichman, Kohli, and Krishnan 2011). Therefore, the advancement and successful implementation of health information systems are necessary in order to provide the finest health services. The benefits of implementing health information systems include automation of processes, faster services, integrated information systems, less errors, and data security (Braa et al. 2007; Bulgiba 2004).

In supporting the advancement of health information technology, this study was designed to investigate factors affecting the implementation success of HIS; HIS being chosen because hospitals are the main health providers in developing countries (Clifford et al. 2008). The scarcity of studies in the area makes it even more necessary that it be examined (Øvretveit et al. 2007a; Shekelle, Morton, and Keeler 2006). Much literature on health implementation has been performed in developed countries, but the findings may not be applicable to developing nations (Malik and Khan 2009).

From the review of extant literature, most studies applied a qualitative methodology utilizing the case study approach (Ammenwerth, Schnell-Inderst, and Siebert 2010; Lluch 2011; Paré and Trudel 2007; Yee, Mills, and Airey 2008). The case study approach is suitable for an in-depth understanding of the implementation process. However, the main constraint with the case study approach is that it takes a longer time to accomplish (Yin 2003). It is also difficult to perform scientific assessment such as measuring the extent of success or failure of the IS implementation with this approach (Heeks 2002; Yin 2003). Consequently, in the current study a quantitative methodology was adopted to overcome these limitations. Findings using numerical values help to explain the magnitude of success or failure. By adopting the quantitative method, the theoretical framework can be explained by using its explanatory power.

This section has clarified different types of IS implementation studies and the significance of research on the implementation of health information systems. Prior to discussing the health information systems' literature, in the next section several pertinent IS theories that can be used for the development of the theoretical framework are discussed.

2.2.3 Information Systems Theories

Theories are required for the following reasons: they explain how a topic is studied; elucidate key assumptions; organize knowledge; provide predictability; and facilitate understanding (Bourke et al. 2010). Essentially, theory helps to explain how things work and why things happen (Germov 2003); it assists in interpreting and analyzing data in order to provide knowledge (Bourke et al. 2010). Thus, theories are useful to help practitioners and academics comprehend the concept in which they believe (Costley 2006). In order to find a suitable theory for IS implementation, a few prominent IS theories were examined; also, IS adoption theories were inspected for the reason that if a newly implemented system is not being utilized, the IS implementation project can be considered a failure.

The Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975) indicates that technology acceptance is determined by one's intent to use technology (*behavior*) and the influence of others on using the technology (*subjective norm* or *social influence*). The theory hypothesizes that, if a person intends to use a system, this could lead to the actual behavior of using the system. Believing that others may want them to use the system also increases the possibility of persons using the system. Nevertheless, TRA is meant for understanding individuals' intentions to use technology and is not about organization. Thus, it is not appropriate to be applied in this study intending to determine a theory that could fit for an individual, group of individuals and organization.

TRA later evolves to become the Theory of Planned Behavior (TPB). TPB added an explanatory variable labeled *perceived behavioral control* which refers to the "perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles" such as getting an 'A' in a course (Ajzen 1991, 188). Therefore, if past experience of obtaining an 'A' is positive and there are not too many obstacles to receiving an 'A', this increases *perceived behavioral control* and, thus, increases the possibility of getting an 'A' (Ajzen 1985, 1991). Linking TPB *perceived behavioral control* in the IS domain refers to the "technology facilitating conditions as well as perceptions of ability". (Kukafka et al. 2003, 220). In other words, *perceived behavioral control* explains factors outside a person's control to adopt technology such as education and training. Again, this model is not suitable to be used in the current study due to it being applicable only to individuals.

TRA is made parsimonious by Davis's (1989) Technology Acceptance Model (TAM), which received wide recognition as explaining users' intentions to use technology. TAM's major contribution to the IS community are *perceived usefulness* and *perceived ease of use* explanatory variables which could be seen as "independent constructs without an explanation on their drivers" (Kukafka et al. 2003, 220). TAM posits that, if a system is useful and easy to use, then this increases the possibility of a person actually using the system. Dixon (1999) later extended TAM to Information Technology Adoption Model (ITAM) to predict technology adoption in cases of a voluntary IT system. Among ITAM shortcomings are its failure to include variables that Davis claims as missing, as well as whether the theory has been formally validated (Ammenwerth, Iller, and Mahler 2006).

The TAM model is well accepted by the research community. Due to its popularity, it has been extended by Venkatesh and others to become Technology Acceptance Model 2 (TAM2) (Venkatesh and Davis 2000), Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003) and Technology Acceptance Model 3 (TAM3) (Venkatesh and Bala 2008). Many studies have used and tested TAM extended models to understand the adoption and diffusion of technology in organizations worldwide (Bandyopadhyay and Fraccastoro 2007; Kijsanayotin, Pannarunothai, and Speedie 2009; Schaper and Pervan 2007a; Venkatesh, Sykes, and Zhang 2011).

Despite the evolution of TAM, and its various models, it is not suitable for the current study as its applicability on mandatory systems is not relevant. In the current study, HIS is regarded as a mandatory system for hospitals. Besides, many studies have shown that *perceived ease of use* in the TAM model is only relevant if the system is voluntary (Ammenwerth, Iller, and Mahler 2006; Callen, Braithwaite, and Westbrook 2008; Davis 1993). Given that the diverse TAM models also fail to include the organizational and clinical factors which have been shown to influence health information systems implementation, TAM and its assortments are excluded from this study (Callen, Braithwaite, and Westbrook 2008; Peute et al. 2010).

Goodhue and Thompson’s (1995) Task-Technology Fit (TTF theory) is based on the interaction between the business processes and technology. This theory posits that technology is likely to be used if the technology, such as health information systems, is able to support the users’ tasks. IT systems that are not beneficial to the users are likely to be ignored. IT integration is also emphasized in this theory since the TTF theory is supposed to be applicable to various roles of users throughout the organization. The main explanatory variable for this theory is the task-technology fit variable. Unfortunately, this theory accommodates individual fit only and the theory is excluded from the current study.

Fit-viability theory is meant to assess the fit feasibility between IT and the business processes to attain sustainable competitive advantage. It emphasizes evaluation of the adoption of mobile commerce and internet technologies (Liang et al. 2007; Liang and Wei 2004; Tjan 2001). The two main dimensions are fit (measures as to whether the feature of the technology matches the needs of the task) and viability (measures the economic feasibility, technical infrastructure and the organization's social readiness). Similar to Goodhue and Thompson's (1995) TTF theory, the fit dimension contends that a better fit between technology and task will lead to better performance. The only difference with the TTF theory is that the individual construct is removed from this model. Conversely, the viability dimension refers to whether the organization, IT infrastructure and economic feasibility are ready for the internet application. Although the main purpose in this theory is to evaluate the internet and mobile commerce application, it can also be used with health applications. Thus, this model is worth further consideration.

Another theory that may explain IS implementation is the dynamic capabilities theory. Dynamic capabilities can be defined as "those that operate to extend, modify or create ordinary capabilities" (Winter 2003, 991). The theory is useful for organizations operating in rapidly changing environments (Teece 2007); it stresses continuous improvement to assure sustained competitive advantage. Dynamic capabilities help an organization to adjust its resources and maintain sustainability (Vaidyanathan and Devaraj 2008). The theory may not guarantee performance enhancement; however, it does hold some promise in that regard (Sher and Lee 2004). Many implementation problems arise because an information system project often is considered as a one-time project when, in reality, IS implementation is a continuous process. After implementation, the system needs to be maintained, modified and upgraded to support user demands. As projected, the theory adopts a process approach and, therefore, it is recognized that there should be continuous change effort with constant improvement (Trkman 2010). Because the process approach takes a longer time to be employed and analyzed; the theory was considered not to be ideal in this study.

Nowadays, many implementation disappointments are brought about by the lack of understanding of socio-technical factors (Ash et al. 2007; Berg 1999). The socio-technical theory, also known as the socio-technical systems (STS) approach, considers both technical and social factors in the design of organizational systems (Baxter and Sommerville 2011; Bostrom and Heinen 1977). The STS approach facilitates better the understanding of how social factors affect the usage of technical systems. This understanding can help management in the design of business processes, technical systems and organizational structures (Baxter and Sommerville 2011). Even though many studies have recognized the impact of socio-technical issues, this method is rarely used as it is thought that the STS approach is difficult to utilize. Among the problems with this approach are inconsistent terminology, lack of agreed success criteria and multidisciplinarity (Baxter and Sommerville 2011).

Contingency theory argues there is no universal or best way of organizing; an effective organizational design may not be applicable in all situations (Fiedler 1964). Therefore, one needs to be cautious when transferring a successful organizational design from one organization to another because it will not result in the same benefits. Each organization must thoroughly study relevant contingencies in its internal and external environments. This theory emphasizes the fit between the business environment and the business processes (Weill and Margrethe 1989). Therefore, the design of an organization must fit with its environments and its subsystems and also among the subsystems (Iivari 1992; Weill and Margrethe 1989). The fit characteristics can affect implementation success or failure (Morton and Hu 2008). Regrettably, the development of the theory has come to a standstill since 1980 (Wade and Tomasevic 2010). Therefore, this model lacks explanatory power and is not considered advisable to be adopted in the current study.

Another well-known theory that has been used to explain IT implementation is Social Cognitive Theory, formerly known as Social Learning Theory; it posits that change in behavior is influenced by personal, behavioral and environmental factors (Bandura 1986). The interactions between a person’s behavior and a person’s environment are driven by their beliefs and thoughts. Thus, *self-efficacy* plays a major role in the theory. Self-efficacy is defined as the beliefs in one's ability to perform a particular behavior. In addition, the belief of favorable outcomes seems to have a positive influence on behavior too (Compeau and Higgins 1995a). In essence, the Social Cognitive Theory seems applicable for the current study and the personal, behavioral and environmental factors are considered relevant.

The Diffusion of Innovation (DOI) theory explains how individuals or users and groups adopt new ideas (Rogers 1995). The main concepts in this theory are *innovation* and *diffusion*. Innovation is an idea perceived as new by users, such as a new health system in the organization; and diffusion refers to the spread of the innovation throughout the organization. As identified by Rogers (1995), the rate of adoption depends on the innovation's relative advantage (perceived benefits); compatibility (perceived reliability); complexity (perceived effort); trialability (can be tried out); and observability (visible benefits of innovation). If users feel that the benefits are substantial, then the adoption rate is faster; and vice versa.

The DOI concept is similar to the Social Cognitive Theory favorable outcomes beliefs. Indirectly, the DOI theory explains the reasons why people are resistant to changes. If users cannot appreciate the innovation benefits then the adoption mission might fail. DOI has been used in a number of health studies to explain technology dissemination (Ash 1997; Doolan and Bates 2002; Hung et al. 2010; Wu, Wang, and Lin 2007). The theory is quite relevant for use in the current study because it includes many levels of analysis, such as for individuals, groups and organizations. Some factors discussed in DOI are used in this study; e.g., organizational, social and technical factors.

The DeLone and McLean IS success theory provides a comprehensive model to evaluate IS success. As discussed earlier, it is difficult to define IS success because it varies depending on *whose* perspective of, *when* (the timing) and *where* (the location) success is being measured. Hence, success can be thought of as a multidimensional variable. Due to this unique characteristic, the measurement for IS success can involve six interrelated dimensions. The model implies that IS success can be evaluated in terms of its quality (system, information and service) and impact (individual, organizational, or net benefits) (DeLone and McLean 1992, 2003). This theory is among the well-accepted theories in the IS literature due to its comprehensiveness. Given the main intention in this study being to investigate the factors affecting successful implementation, the theory is found appropriate to be included in the theoretical framework. Further elaboration of the theory can be found in Section 3.2 of Chapter 3.

CSFs may be applied for both planning and requirement analysis (Boynton and Zmud 1984). As the intention in the study is to find ways to implement HIS successfully, the CSFs approach gives the best advantage to accomplish the study. The theory is the major theory used in the construction of the study's independent variables. Therefore, an exhaustive explanation of this theory is conducted in Section 2.2.3.1. From the previous discussion, IS theories that accentuate individuals are excluded in the study; only theories that encompass individual, group, organizational and clinical factors are taken into account. IS theories that have been discussed are summarized in Table 2.3.

Following an exhaustive investigation of the variety of IS theories and a study of their characteristics and benefits, it was decided that the theoretical framework in this study was mainly a combination of the critical success factors theory and the DeLone and McLean IS success theory. IS theories are combined because it is difficult to realize the research objectives using a single theoretical framework. Moreover, integrating multiple theoretical frameworks helps in explaining complex issues. The theoretical framework of the study is elaborated in Chapter 3.

Table 2.3: Prominent IS Theories on IT Implementation

Authors	Level of Analysis	Theory	Brief Description	Suitability of IS Theory for this Study
Fishbein and Ajzen (1975)	Individual	Theory of Reasoned Action (TRA)	Posits that individual behavior is driven by behavioral intentions and subjective norms surrounding the performance of the behavior.	Not Suitable
Davis (1989)	Individual	Technology Acceptance Model (TAM)	Based on TRA. Theorizes that perceived usefulness and perceived ease of use determine an individual's intention to use a system with intention to use serving as a mediator of actual system use.	Not Suitable
Ajzen (1991)	Individual	Theory of Planned Behavior (TPB)	TPB suggests that individual behavior is driven by behavioral intentions where behavioral intentions are a function of an individual's attitude toward the behavior, the subjective norms surrounding the performance of the behavior and the individual's perception of the ease with which the behavior can be performed (behavioral control).	Not Suitable
Goodhue and Thompson (1995)	Individual	Task Technology Fit (TTF)	IT is more likely to have a positive impact on individual performance and be used if the capabilities of the IT match the tasks that the user must perform.	Not Suitable
Dixon (1999)	Individual	Information Technology Adoption Model (ITAM)	Builds on TAM and provides a framework for implementations and evaluations with a focus on individual users to predict the adoption of voluntary information technology.	Not Suitable
Venkatesh and Davis (2000)	Individual	A theoretical extension of TAM (TAM2)	Develops on TAM to include social influences and cognitive instrumental processes that is conceived to have significant influence on user acceptance.	Not Suitable
Venkatesh et al. (2003)	Individual	Unified Theory of Acceptance and Use of Technology (UTAUT)	A combination of eight models: TRA, TAM, TPB, DOI, Social Cognitive Theory, motivational model, a combined TAM and TPB model and PC utilization model that explains usage intention.	Not Suitable
Venkatesh and Bala (2008)	Individual	TAM3	A combination of TAM2 and the determinants of perceived ease of use (PEOU).	Not Suitable

Authors	Level of Analysis	Theory	Brief Description	Suitability of IS Theory for this Study
Fiedler (1964)	Firm, Individual	Contingency Theory	Stresses that there are no best practice in organization design. The design of an organization must fit between the organizational subsystems and business environment.	Not Suitable
Bostrom and Heinen (1977)	Organization, Employees, Environment	Socio-technical system theory	Consideration of the human factor in system design.	Not Suitable
Rockart (1979)	Individual, Group, Organization	Critical Success Factors (CSFs)	Determines the essential factors that an organization must have to enable successful project implementation.	Suitable
Bandura (1986)	Individual, Group	Social Cognitive Theory	Provides a framework for understanding, predicting and changing human behavior. Explains individuals' reactions to computer technology.	Suitable
Barney (1991)	Capability, Firm	Dynamic Capabilities	Emphasizes that improvement is a continuous process to assure sustained competitive advantage.	Not Suitable
DeLone and McLean (1992, 2003)	Individual, Organization	DeLone and McLean IS success	A multidimensional measuring model to comprehend IS success.	Suitable
Rogers (1995)	Group, Firm, Industry, Society	Diffusion of Innovations Theory (DOI)	DOI theory sees innovations as being communicated through certain channels over time and within a particular social system. Individuals are seen as possessing different degrees of willingness to adopt innovations and thus it is generally observed that the portion of the population adopting an innovation is approximately normally distributed over time.	Suitable
Tjan (2001)	Organization	Fit-viability Theory	An extension of the TTF model with the removal of the individual construct. Fit and viability are considered to affect technology performance.	Not Suitable

Note: These theories are sorted according to year and level of analysis.

2.2.3.1 Critical Success Factors

“The goal for any enterprise can be stated as getting the right thing done, the right way, at the right time, by the right person” (Stead and Lorenzi 1999, 345). Agreeing to this concept, the intention in this study is to gather the most appropriate factors for HIS implementation. After reviewing the literature, the CSFs theory seems to correspond with this notion. CSFs are the key areas where “things must go right” for the organization to prosper (Rockart 1979, 85). Since the introduction of CSFs, it has become a popular approach to determine the essential factors that an organization must have in order to attain organizational goals. Furthermore, the CSFs approach is effective in defining information needs (Rockart 1979).

Rockart (1979) emphasizes that, as CSFs are limited, management is able to focus on the pertinent CSFs until they are accomplished. In this study, the CSFs approach is used to identify candidate factors that may influence a successful conclusion to project implementation. By identifying CSFs, required resources may be allocated accordingly to meet priority issues. Among the strengths of the CSFs approach are that it generates acceptance at managerial levels; develops strategic plans; facilitates planning process; focuses attention on core set of essential issues; identifies implementation issues and may be continuously examined for validity and completeness in establishing guidelines for monitoring the organizations' activities and assist in improving organizational performance. Downsides of CSFs include that they are difficult to use; have possible analyst and manager bias; and may not represent the actual environment. (Boynton and Zmud 1984; Forster and Rockart 1989). Given that the CSFs weaknesses could be overcome with adequate specialist support, this theory seems most appropriate for the current study (Forster and Rockart 1989).

It is impossible to list a definite set of all critical factors useful in stimulating successful HIS implementation because they differ between projects, companies and countries (Berg 2001; Fortune and White 2006). Much research on CSFs has focused on identifying the individual factors though this approach has been heavily criticized as some of the factors overlap or they are highly correlated (Belassi and Tukel 1996;

Cooke-Davies 2002; Fortune and White 2006; Pinto and Slevin 1989). This kind of research, which is often referred to as ‘factor studies’, is no longer adequate to understand the implementation process. Accordingly, there seems to be a lack of formal studies that analyze the relationships among success factors (Ang, Sum, and Yeo 2002; Esteves, Casanovas, and Pastor 2003; Sawah, Tharwat, and Rasmy 2008). This study is designed to fill the void by addressing CSFs interrelationships.

Most CSFs studies hypothesize that the absence of CSFs would lead to failure of the project (Poon and Wagner 2001). CSFs are considered to be both necessary and sufficient conditions for system success. However, Berg (2001) argues that the implementation factors may only be discovered during the implementation process itself and one should not attempt to pre-specify or control the process. Berg recommends that the control for planning should be replaced with experimentation and mutual learning. If time and money are not limitations for most implementation project, perhaps Berg’s approach to identify factors could be used. Unfortunately, the two elements of time and money are the biggest constraints in most IS implementation projects. Particularly in HIS implementation, money needs to be divided for the growth of the hospital’s staff, equipment, medical supplies and information systems.

This study developed on the belief held in most CSFs literature where success may not be guaranteed by meeting the required CSFs; however, failure to consider the CSFs is a major deterrent to success. In this study, the CSFs are categorized to allow similar factors to sit under one category. For example, candidate factors such as *strong leadership*, *experienced project champion* and *management support* are group under the *top management* category. Commonality among factors is used to re-classify factors in order to simplify the study framework; i.e., CSFs are grouped into seven categories: 1) top management and project championship, 2) business plan and vision, 3) enterprise-wide communication, 4) project management, 5) team composition, 6) change management and culture program and 7) system selection and technical implementation. Justification of the seven factors and the attribute measurements for each category are discussed in Section 3.3.2 of Chapter 3.

2.3 Hospital Information Systems

The compelling idea of IT and its advantages seems to have pervaded the health domain over the past 50 years. Despite the plethora of IS and IT benefits, implementing IS in the health domain confronts many potential disappointments (Berg 2001; Kaplan and Harris-Salamone 2009; Lluch 2011; Lorenzi and Riley 2000). This situation must be remedied to attain competitive advantages.

Research in the health sector is important because, unlike in other industries, health environments are distinctive. Implementation factors that are successful in other business arenas may not work necessarily in the healthcare domain (Ammenwerth, Gräber, et al. 2003; Anderson and Stafford 2002). There are many subtle differences between healthcare and other domains; e.g., the way information is processed, the complexity of the healthcare products, the various stakeholders involved and the dependency on legislation, among others (Ammenwerth, Gräber, et al. 2003). Other motives for choosing health information systems as the main subject of investigation in this study have been described in Section 2.2.2. This thesis attempts to further narrow its research scope by specific study in HIS. Hospitals' systems are chosen because implementation studies in this area are scarce due to the difficulty of accessing hospital sites and the lengthy period of implementation (Aarts, Doorewaard, and Berg 2004; Ammenwerth, Gräber, et al. 2003).

The main challenge in conducting the literature review for HIS is that there are too many keywords or terms that can be used during the search for relevant, extant literature. This is due to the enormous range of HIS applications in healthcare systems. Thus, to strategize the literature review, keywords such as hospital information systems (HIS), health information systems, medical information systems, clinical information systems (CIS), computerized physician order entry (CPOE), patient care information systems, patient data management systems, medical informatics, health informatics, hospital informatics, electronic patient record (EPR), electronic health record (EHR), electronic medical record (EMR), telemedicine, telehealth and their variations were considered relevant.

The keyword ‘information technology’ was used also alongside ‘information systems’. As discussed at the beginning of this chapter, many researchers seem to use the terms IT and IS interchangeably regardless of the difference in meaning. For example, some journal articles favor the term ‘health information technology’ instead of ‘health information systems’. Therefore, it was necessary to include both terms to ensure thoroughness in the literature review. To make the literature review search more specific, the keywords were combined with the following terms, ‘implementation factors’ or ‘implementation success’ or ‘implementation framework’.

To further reduce the number of articles to be reviewed, articles that have no direct relationships with HIS implementation success factors are excluded; such topics as IS/IT outsourcing, ethical, data exchange between hospitals, security and safety. Articles published prior to year 1995 also were discarded except for a few seminal papers or highly referenced articles. Due to the lack of research in the discipline, sometimes articles published in the early 1990s were used to guide the research development process. Based on the review of literature, HIS has been defined in many different ways and portrays various views as listed in Table 2.4. As there was no indication of consensus regarding the definition of HIS, in the current study HIS has been defined as: *a computerized integrated information system that manages hospitals’ administrative, financial and medical information*.

Among the benefits of an HIS system are that it includes automate tasks, fast retrieval of records, simplifies projections tasks, improves productivity, speedily assesses bed vacancies, hastens lab test results, shortens waiting time, schedules appointments, avoids misplaced records, reduces errors and provides a repository of valuable information (Bulgiba 2004). Bulgiba (2004) adds that the benefits of HIS aid in achieving enhanced patient safety aspects because life-saving decisions may be performed faster and inaccurate drug prescriptions may be minimized. Further, Goldschmidt (2005) supports the view that HIS lessens administrative expenses, improves the quality of patient care, automates sharing of health information and reduces the risk of negligence. Despite all these benefits, many studies are still reporting HIS implementation failures (Anderson 1997; Anderson and Aydin 1997;

Berg 1999, 2001; Kaplan and Harris-Salamone 2009; Lorenzi and Riley 2000). Therefore, it is as vital to resolve implementation disappointments as it is to obtain the benefits of HIS.

Table 2.4: Alternative HIS Definitions

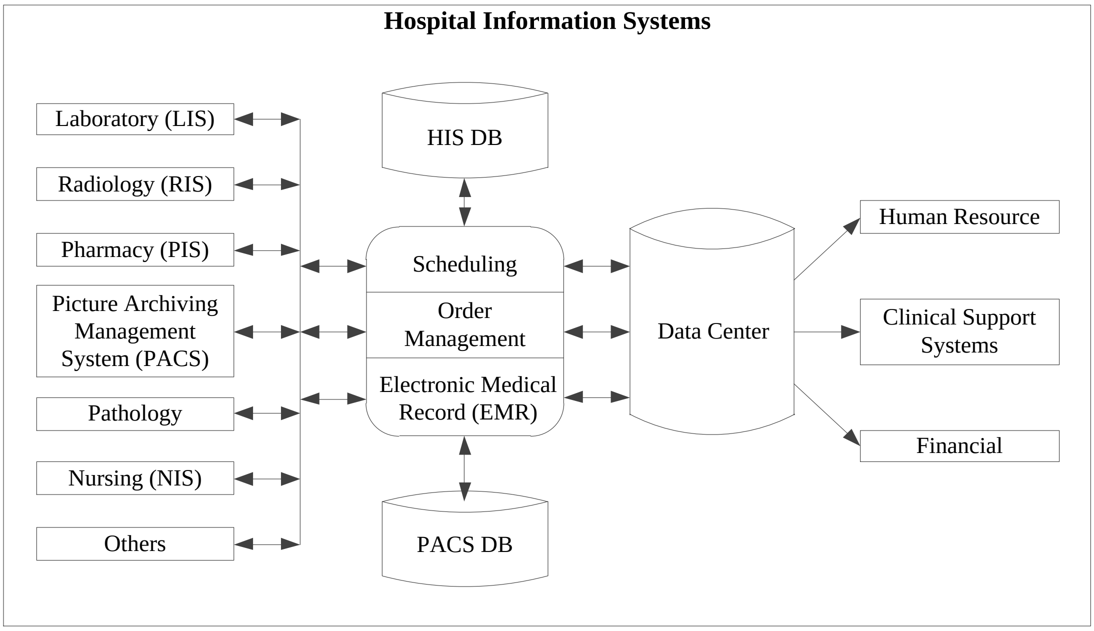
Authors	HIS Definition
Aggelidis and Chatzoglou (2008, 101)	"is a computer-based system designed to facilitate the management of the administrative and medical information within a hospital"
Biohealthmatics.com (2006, 1)	"computer system that is designed to manage all the hospital's medical and administrative information in order to enable health professional perform their jobs effectively and efficiently"
Haux (2004, 30)	"is the socio-technical subsystem of a hospital, which comprises all information processing as well as the associated human or technical actors in their respective information processing roles".
Honeyman (1999, 218)	"a hospital-wide information system used to access patient information, reports from various services, and billing information"
Kuhn and Giuse (2001, 275)	"HIS has been used similar to the IS definition" "a system, whether automated or manual, that comprises people, machines, and/or methods organized to collect, process, transmit, and disseminate data that represent user information"
van Bemmel and Musen (1997, 576)	"an information system used to collect, store, process, retrieve, and communicate patient care and administrative information for all hospital-affiliated activities and to satisfy the functional requirements of all authorized users"
Winter and Haux (1995, 379)	"all the information processing activities within a certain hospital" "the partial system in a hospital, which is dealing with the complete information processing and information storage of the hospital"
Winter et al. (2001, 101)	"to support patient care and the associated administration" "provide information, primarily about patients, knowledge, primarily about diseases, drug actions and adverse effects-to support diagnosis and therapy; information about the quality of patient care and about hospital performance and costs" "A hospital information system is that socio-technical subsystem of a hospital, which comprises all information processing actions as well as the associated human or technical actors in their respective information processing role"

Source: Author.

Typically HIS have subsystems such as Clinical Information System (CIS), Financial Information System (FIS), Laboratory Information System (LIS), Pharmacy Information System (PIS), Radiology Information System (RIS), Picture Archiving Management System (PACS) and the Nursing Information System (NIS)

(Biohealthmatics.com 2006). See Figure 2.3 for a typical view of how the HIS subsystems connect. The number of subsystems to be installed is decided by the hospital management; implemented separately by an *incremental* approach or simultaneously by means of a *big bang* approach.

Figure 2.3: HIS and its Subsystems



Source: Adapted from Wainwright and Waring (2000).

The *'big bang'* installs the entire system at once whereas an *incremental* approach allows users to implement a few subsystems at a time. An *incremental* approach is greatly recommended because it allows the users to become accustomed to the new system gradually. Many authors caution about the danger of the *'big bang'* approach since it does not permit users to adapt progressively to change (Anderson and Stafford 2002; Jones 2003; Ludwick and Doucette 2009). The descriptions for HIS subsystems and analogous health systems are described in Table 2.5.

Table 2.5: Taxonomy of Information Systems in Healthcare

Authors	Information Systems	Description
Institute for Telecommunication Sciences (2000, 1); Kuhn and Giuse (2001, 275)	Information System (IS)	"a system, whether automated or manual, that comprises people, machines, and/or methods organized to collect, process, transmit, and disseminate data that represent user information".
Kuhn and Giuse (2001, 275)	Health Information System or Healthcare Information System	"a system, whether automated or manual, that comprises people, machines, and/or methods organized to collect, process, transmit, and disseminate data that represent user information" in healthcare.
van der Meijden et al. (2003, 236)	Patient Care Information System (PCIS)	"a patient care information system was defined as a clinical information system (CIS) in use in inpatient settings, requiring data entry and data retrieval by health care professionals".
Blum (1986); Bulgiba (2004, 65)	Clinical Information System (CIS)	"computer-supported applications with a relatively large and long term data base containing clinical data that are used to assist in the management of patient care". "is also known as Electronic Medical Record (EMR)".
Doolan and Bates (2002, 181)	Computerized Physician Order Entry (CPOE) or Physician Order Entry (POE)	"as the direct entry of diagnostic tests, medications, patient care, and referrals orders into a computer by a physician or other authorized prescriber such as a nurse practitioner (in some instances, a medical student or nurse may initially enter the order, and the physician signs off the order before it is acted upon)".
Classen (1994, 908)	Laboratory Information System (LIS)	"a computer-based information system that supports laboratory functions for collecting, verifying, and reporting test results".
Liaskos and Mantas (2002)	Nursing Information System (NIS)	"is a part of a health care information system that deals with nursing aspects, particularly the maintenance of the nursing record".
Classen (1994, 908)	Pharmacy Information System (PIS)	"a computer-based information system that supports pharmacy personnel".
Honeyman (1999, 219)	Radiology Information System (RIS)	"a system specifically designed to place radiology orders, to receive interpretations, and to prepare bills for patients".
van Bemmel and Musen (1997, 588)	Picture Archiving Communication System (PACS)	"a system for digital acquisition, storage and retrieval of images".
Shortliffe and Cimino (2006); van Bemmel and Musen (1997); van der Lei (2002, 53)	Clinical Decision Support System (CDSS)	"any computer program designed to help health professionals make clinical decisions".
Field (1996); Hebert (2001, 1145); Reid (1996)	TeleHealth	"health care services through electronic information and communication technology (ICT), where participants are separated by geographic, time, social and cultural barriers".

Source: Author.

The numerous information systems in healthcare have been classified in many ways. The purpose of classification is to lessen the confusion of various terms used in the HIS literature. Regardless of how IS in healthcare are classified, an implementation framework can be helpful to advance successful implementation of the systems. Thus, several databases have been investigated to review evaluation and implementation studies; other sources include textbooks and web pages. Factors that are ranked highly in these evaluation and implementation studies have been identified for further investigation; the intention being to examine whether these factors are relevant (or not) for developing countries. Hence, building on previous studies of HIS evaluation and implementation, the list of identified factors has been grouped and described in Section 3.3 of Chapter 3. The next section compares and contrasts the existing evaluation frameworks of HIS.

2.3.1 HIS Evaluation

As mentioned in Section 2.2.1, evaluation studies, either formative or summative, can be used to help improve a given system. The intention in this section is to elaborate on the meaning of evaluation in health informatics by answering *why* evaluation studies are necessary, determining *who* are involved, *what* characteristics are evaluated, *when* evaluations are conducted and *how* to conduct an evaluation study. Wyatt and Spiegelhalter (1990) classify three main reasons as to *why* evaluation is needed; viz., ethical, legal and intellectual. Ethically, evaluation ensures that the system is improved for the benefit of the patients and, legally, evaluation ensures that the system is safe so as to avoid mishaps such as erroneous medication prescriptions. Intellectually, evaluation is undertaken to ascertain whether or not the performance and development of the system are improved consistently.

Further, Friedman and Wyatt (2000) clarify the *why* and *who* questions of evaluation. They explain that evaluation helps to: promote information systems usage; examine the information systems structures and functions; learn from failed implementation; determine that the system is safe; and reduce liability risk of having a flawed system. In addition, they note that various stakeholders are involved in an evaluation study; e.g., such as developers, users, administrative workers, patients and management executives. Therefore, the perspectives of all stakeholders should be addressed in an evaluation study. In this study, the stakeholders involved are the users of HIS which comprises physicians, nurses, pharmacists, laboratory technologies, vendors, management and non-management workers.

Kaplan (1997) clarifies the *what* and the *how* questions of evaluation by arguing that a complete evaluation study plan should: 1) focus on technical, organizational and economical aspects; 2) use multiple research methods in order to maximize understanding; 3) be adaptable if unexpected issues arise; 4) be longitudinal to capture change processes; and 5) be formative and summative in order to improve the information systems. In this study, where the main focus is on the HIS implementation aspects, a hybrid evaluation comprising formative and summative evaluations is used to create the conceptual framework. As an evaluation study may be performed prior to implementation, during implementation or post implementation, in the current study evaluation is performed post implementation. Instead of adopting a mixed method approach in the current study, it was determined to use a quantitative method in order to measure the extent of IS successes and failures and enrich the literature of health systems where many studies seem to adopt the case study approach (Ammenwerth, Schnell-Inderst, and Siebert 2010; Lluch 2011; Paré and Trudel 2007; Yee, Mills, and Airey 2008). Hence, variation of methods is desirable in order to provide an exhaustive understanding of the implementation process.

In this section there is not an exhaustive list of all evaluation studies that have been performed on health systems. Instead, a summary of HIS evaluation studies, particularly on implementation factors, is presented in Table 2.6. Given the objective in the study is to find factors that possibly may affect implementation success, examining evaluation studies that discuss this specific topic seems most appropriate.

Many evaluation studies highlight the complexity of healthcare processes and stakeholders' diverse expectations as the main reasons for implementation failure. Therefore, prior studies propose that HIS implementation can be improved by considering the socio or human factors, the fit between tasks and the technology, and organizational culture. The main weakness in these studies is that the majority adopted the case study approach. The problem with the case study approach is that it cannot be generalized and used in other organizations (Yin 2003). As stated in the contingency theory description, the best practice of one organization may not work in other organizations. Then again, findings from the case study approach can be used as a guide for other researchers. As a result, recommendations from past research are used in developing the current implementation framework.

2.3.2 HIS Implementation

In line with the study objective (to develop a framework that identifies factors affecting successful HIS implementation), the HIS implementation studies have been reviewed. This section is divided into three parts to facilitate the discussion of HIS implementation. The first part deliberates on HIS implementation in developed countries; the second discusses the barriers of HIS implementation and success stories in developing nations; and the last section compares and contrasts implementations factors from the developed and developing countries. Malaysia is a budding nation in HIS implementation; consequently, learning from the experiences of others is useful to guide the development of a successful implementation framework.

2.3.2.1 HIS in Developed Countries

In this study, the term *candidate* factors refer to contingency or potential factors that can be classified as critical success factors for HIS implementation. Following the literature, it appears that many researchers endeavor to list the candidate factors into various forms. Based on the review, a few candidate factors seem prominent and appear in almost all the literature. After analyzing the commonalities between these factors, the researcher has reclassified the factors as discussed further in Chapter 3 (Section 3.3.2). The explanation regarding the use of these factors is separated to avoid repeated deliberation.

Table 2.6: Evaluation Studies on HIS Implementation

Authors	Summary	Findings
Berg (2001)	Discusses 3 myths that prevent successful implementation.	PCIS implementation should be supported by the management and PCIS users. Any IS implementation project should not be solely administered by the IT department and it should be adaptable as to allow organizational changes.
van der Meijden et al. (2003)	Review on success factors of patient care information systems using the DeLone and McLean IS success models	The DeLone and McLean IS success model is applicable in the evaluation of patient care information systems. Future enhancements should include contingent factors such as user involvement and organizational culture.
Littlejohns, Wyatt, and Garvican (2003)	Evaluating computerized health information systems in South Africa	Reasons for implementation failures are: neglecting healthcare cultures; underestimating the complexity of healthcare processes; different expectations of implementer, developer and users; long implementation process; keep on investing on fail projects; and failure to learn from past projects.
Aarts, Doorewaard, and Berg (2004)	Identify organizational factors for successful information systems implementation.	'Fit' between the system and the work practice is the key factor for successful implementation of CPOE system.
Ammenwerth, Iller, and Mahler (2006)	Identify socio-organizational factors that influence IT adoption.	Confirm that 'Fit between Individuals, Task and Technology' (TTF) framework is capable of explaining IT adoption failures.
Brender et al. (2006)	Determine factors influencing success and failures of health informatics applications.	Identified 110 success factors and 27 failure criteria. The most successful factors are: collaboration and cooperation, setting goals and courses, and user acceptance. Factors for failure are: response rate, lack of organizational understanding, and unable to gauge HIS impacts.
Nykänen and Karimaa (2006)	Identify success and failure factors in the design process of a regional health information systems.	Successful design begins from modeling of work processes, data and information flows and definition of concepts and their relations.
Ludwick and Doucette (2009)	Review of health information systems implementation from seven countries.	The review exposes the socio-technical factors, or 'fit' factors such as leadership, project management, standardization, and training that affect implementation
Yusof, Papazafeiropoulou, et al. (2008)	Investigate evaluation frameworks for health information systems.	Evaluation frameworks should combine technological, human, and organizational aspects in order to provide a comprehensive evaluation study.
Yusof, Kuljis, et al. (2008)	Determine that a new evaluation framework is suitable for comprehensive evaluation.	Demonstrate that the 'Human, Organization, and Technology–fit' (HOT-fit) evaluation framework is able to perform a thorough HIS evaluation.

Source: Author.

In this section, recent literature has been reviewed to countercheck whether the findings in this research are still valid and relevant to the present time. A quick inspection of contemporary literature suggests that the candidate factors used to build up the theoretical framework are still significant. This section also is used to discuss reasons why some important candidate factors are not used in the theoretical framework.

To date, current research studies are reporting on investigations into factors affecting implementation. The reason for continued academic attention is that, despite the promises built into HIS/HIT, the systems are difficult to implement (Kaplan and Harris-Salamone 2009; Lluch 2011; Taylor et al. 2005). Consequently, this counts as evidence that the efforts in the current study remain in demand and are worthwhile. Some literature has suggested that government policy on healthcare is an effective way to promote HIS/HIT adoption (Abraham, Nishihara, and Akiyama 2011; Taylor et al. 2005). Findings are supported by illustrating quantitative benefits obtained after implementing HIT; such as reduction of medication errors by 46 percent, improvement of patient care by 66 percent and reduction of waiting time by 45 percent. Although agreeing that government support is significant in implementing HIS, *government support* was not used in the current study as one of the factors affecting HIS success. The main reason for opting not to include government support being that the study was conducted in public hospitals which are owned by the government. Therefore, when top management support is nominated as one of the factors affecting success, the factor implicitly represents government support.

Implementation barriers reviewed for the study reported that technology is not the problem; rather, the lack of socio-technical consideration prevents successful implementation (Aarts et al. 2010; Berg, Aarts, and van der Lei 2003; Lluch 2011). Lluch's (2011) review of HIS implementation barriers suggests that the organizational structure, tasks, people policies, incentives, information and decision processes must be improved to achieve HIS success. In relation to organizational structure, consideration must be given to the younger employees who represent Generation Y (Gen Y). To date, there is no consensus over the exact birth dates that define Gen Y. The broadest definition includes those who were born between 1978 and 1988 (Martin 2005). With Gen Y employees entering the task force, the healthcare hierarchical structure needs restructuring to best leverage the potential of Gen Y workers (Yee 2007; Yee, Mills, and Airey 2008). In addition, the physicians' autonomy needs to be considered; it has been suggested that many of the HIS applications are underused by physicians (Ash, Stavri, et al. 2003; Fichman, Kohli, and Krishnan 2011; Venkatesh, Zhang, and Sykes 2011).

During the development of the theoretical framework, both these ideas are not included as direct factors influencing HIS success. Both Gen Y and physician autonomy are noteworthy ideas, but they are not dominant factors. Therefore, these factors were considered as part of the research framework with moderating variables such as gender, age, technology experience, project role, job position and education level. Detailed explanation of the moderating variables is discussed in Section 3.3.3 of Chapter 3. By testing the influence of age indirectly examines the impact of Gen Y. However, due to the difficulty of determining physician autonomy measurements in a quantitative way (Levenson, Atkinson, and Shepherd 2010), this factor was not included in the research framework.

An obvious distinction in recent research has been the emergence of new technologies. For instance, a recent study presented by Yao, Chu and Li (2011) is centered on Radio Frequency Identification (RFID) technology for the healthcare systems. The RFID technology uses radio waves for data collection and transfer. It is more advantageous than the current barcode scanning technology and does not require human intervention; most importantly it provides efficient and accurate medical data (i.e., it tracks medical equipment, supplies and people such as personnel and patients) for healthcare professionals. The Yao, Chu and Li study applies Slevin and Pinto's (1987) critical success factors with some customization. Yao, Chu and Li realized that more studies are needed to validate their CSFs framework. Correspondingly, the current study also has analyzed the success factors suggested by Slevin and Pinto (1987).

Yao, Chu and Li modified Slevin and Pinto's CSFs to include two more factors; viz., 1) consideration for data privacy and 2) selecting reliable and experienced vendors.

Although these two factors are not shown as part of the current study's theoretical framework, it is realized that *data privacy* is an important component; rather, data privacy should be a feature of the information systems and not a factor affecting successful implementation. Those accountable for selecting the system should ensure that the data privacy characteristics are built into the system. As a result, in the study, *system selection* was chosen as one of the candidate success factors instead of using the *data privacy* factor. Data privacy also can be an act introduced by the hospitals; in this case, top management must be the responsible entity to uphold the issue.

Vendors support often is considered crucial, particularly when implementing new technologies. However, in this study, this factor is not made obvious as an independent factor influencing the implementation project. In trying to build a comprehensive implementation framework, the vendor factor is combined as part of the team composition. Vendors, together with a balanced business and technical personnel form the implementation team and are discussed further in Section 3.3.2.5 in Chapter 3. Other characteristics of team composition include adequate business and technical skills and that the implementation team should be given the authority to select the appropriate information systems in the best interest of the organization.

The above items are indicative of factors cited in recent studies on HIS implementation and, although there are more recent articles that have been reviewed, due to the similarity or redundant findings, they are not discussed in this section. The next section discusses HIS implementation in developing countries.

2.3.2.2 HIS in Developing Countries

As discussed earlier, IS and IT are perceived as having an immense benefit in delivering better health services; therefore, it is not surprising that HIS is being implemented worldwide. In developing nations, economic disadvantages seem to be the main hindrance to healthcare expansion (Clifford et al. 2008). A study in Nigeria reported that among the implementation problems are those caused by political and economic instability, poor telecommunication infrastructure, inadequate monetary and human resources, interrupted electricity and water services, corruption and cultural influences (Benson 2011; Cline and Luiz 2011); findings that are similar in the majority of developing nations that have a high poverty level (Braa et al. 2007; Clifford et al. 2008; Kimaro and Nhampossa 2005; Walsham and Sahay 2006).

Apart from corruption and cultural influences, most problems reported by Benson (2011) are related to economic instability; the findings are rather unique because culture, for example, has many layers such as national, regional, religious, gender, generation, social class, organizational and departmental levels (Hofstede, Hofstede, and Minkov 2010). This subject alone can be another major research topic because the multi-layers of culture may affect HIS implementation and adoption in numerous ways. As a result, cultural influences are examined in the current study. Also, corruption can be perceived as part of the culture in certain countries (Balcı et al. 2011; Miller, Grødeland, and Koshechkina 2001; Moreno 2002). Yet, corruption can also be an offensive topic in some countries. Although the presence of corruption is acknowledged, the details of corruption are often less reported or not reported at all due to the difficulty of gathering evidence. For that reason, the topic of corruption has been omitted from this study.

An interesting fact that does need to be investigated in this study is that most HIS developers are from the developed countries (Braa et al. 2007; Heeks 2002). There are possibilities in designing the HIS systems that may not be generic enough to be suitable globally, especially for developing countries. The work practices and cultures in developing countries are usually different from those of developed nations; therefore, software customization is often unavoidable. There is a possibility that due to the 'fit' problem between the system and the organization's activities [tasks], successful implementation is delayed or unachievable. In Asia, for example, entering data into a simple *name* field can be cumbersome because Asian names differ widely from the Western naming convention that usually has a first and a last name (Soh et al. 2003; Soh, Kien Sia, and Tay-Yap 2000). Besides, there is also a shortage of highly skilled and competent technical staff to maintain and customize the HIS systems. Hence, the dependency on vendors is inevitable (Chen et al. 2006; Dedrick and Kraemer 2011). It is worth considering these issues in establishing the theoretical research framework.

Frequently in developing countries, the health infrastructure and services expansion are concentrated in urban areas; those living in rural regions have to be referred by their local doctors to use the high-end health services (Ariff and Teng 2002). Many experts in the health sector have tried to promote telemedicine to these rural places (Ariff and Teng 2002; Bashshur, Reardon, and Shannon 2000; Martinez et al. 2005; Wootton 2001). Telemedicine can be perceived as an "integrated system of healthcare delivery that employs telecommunications and computer technology as a substitute" for doctors (Bashshur 1995, 19). Despite telemedicine benefits, it is not the optimal solution to HIS problems in rural areas. It may ease human resource shortage issues (e.g., doctors and nurses), but telemedicine is still a type of information system (Cline and Luiz 2011). Other barriers still exist; namely, knowledgeable and skilled staff, employees' resistance and lack of telemedicine policy (Isabalija et al. 2011).

Other research findings in extant literature from developing countries seem to be similar to those from developed nations. Most literature emphasizes the involvement of all interested parties particularly the management, the importance of leadership, suitable organizational structure, people orientation in project selection, continuous training, system readiness, and persistence over time as the keys to successful IS projects implementation (Cline and Luiz 2011; Krishna and Walsham 2005). Consequently, together with government support, health policies and guidelines, IS sustainability is achievable even in developing countries (Isabalija et al. 2011).

Despite being a multi-ethnic society, the government has put considerable effort into uniting and managing the Malaysian population. Malaysia, as a developing nation, is fortunate to have a relatively stable economy. The gross domestic product (GDP) can be used as an indicator for economic stability and, based on the International Monetary Fund (IMF) 2011 and World Bank 2011 reports, Malaysia can be regarded as economically stable (International Monetary Fund 2011; The World Bank 2011). Connecting this fact to HIS implementation, health infrastructure limitations may not be the main issue for the advancement of this sector. After analyzing all the factors found from the developing as well as from the developed countries, it was decided only factors pertinent to Malaysia would be used in the development of a theoretical framework for the study. The candidate factors chosen for the theoretical framework are top management and project championship, business plan and vision, enterprise-wide communication, project management, team composition, change management and culture program, system selection and technical implementation. These factors are discussed in Chapter 3.

2.3.2.3 Gaps between Developed and Developing Countries

From the previous explanation regarding HIS implementation in developed and developing countries, the main gap seems to be related to cultural influences. As discussed, culture has several layers. This study utilized the multiple layers of culture as moderating variables during examination of the theoretical framework. The effect of gender, organizational, and national culture are tested in Chapter 5 and discussed further in Chapter 6.

Previously, it has been noted that almost all HIS systems packages are designed in and for developed countries (Braa, Monteiro, and Sahay 2004; Heeks 2002). As a result, the business processes that are built into the system may not be applicable to developing nations. Some studies have demonstrated that users have to make substantial adjustments or changes in trying to accommodate the systems and not the other way around (Hong and Kim 2002; Zhang et al. 2005). Although most HIS systems can be tailored and customized to suit the needs of an organization, vendors are unwilling to modify their applications. If the organization insists on modifying the system, significant costs can be incurred for the current project as well as for future maintenance and upgrades.

Although vendors always do their best to make their applications as generic as possible so that they can be applied to multiple organizations, they are reluctant to customize these applications for the reasons that it is easier for them to maintain the original system and it is also more cost effective (Reiner and Siegel 2001). A possible alternative to this dilemma is to provide users with adequate training to adapt the system or compromise with a change in the organizations business practice. In an effort to address this gap, the change management and culture program is utilized as one of the candidate factors in the theoretical framework with training being one of the activities in the change program.

Gaps between the developed and developing countries (see Table 2.7) cannot be addressed simply by the theoretical framework; e.g., economic instability and the concern of HIS being implemented mostly in urban areas or cities. These two factors can be linked together because the speed of implementation expansion normally depends on the stability of the economy. Many have tried to capture the economic instability or economic uncertainties factor in their research model (Belassi and Tukel 1996; Bryson and Bromiley 1993; Zhang et al. 2005). Given that economic issues can be related to the environment, it is sometimes referred to as the economic environment factor or external factor. Due to its subjectivity, it is difficult to be measured. For example, many dispute the measures for economic stability (Dedrick, Gurbaxani, and Kraemer 2003; Stiglitz, Sen, and Fitoussi 2009). As a result, in the current study economic factors were not added to the theoretical framework due to the complexity of determining measurement items.

In regard to the frustration of HIS being implemented in urban areas, this is the decision of the government or the health providers. Typically, the government is in charge of the distribution of the public sector health services and the latter [health providers] are responsible for the private sector healthcare amenities. In China for example, the health system expansion begins from the urban areas and later to the rural areas following demands by the population (Liu, Hsiao, and Eggleston 1999). Many researchers have criticized on the inequity of the healthcare expansion (Whitehead 1992), and argued that both urban and rural populations should receive the same health services. Considering that many people from the rural areas have migrated to the cities in search of better living conditions, this issue should no longer be contestable. Healthcare expansion should be provided according to people's needs. In Malaysia, HIS implementations are done in stages, starting from the urban areas where there is more demand and budget, and, subsequently extended to the rural areas (Merican 2002).

Table 2.7: HIS Implementation Differences – Developed and Developing Countries

	Developed Countries	Developing Countries
Economy	Economy growing at a constant rate, productivity increasing, high standard of living.	Economy growing at an uneven rate, productivity fluctuates, low standard of living.
Culture	Lack of corruption. Individualistic and low power distance.	Differences of culture at several levels such as national, regional, religious, gender, generation, social class, organizational and departmental level. Most developing countries are more protective of the livelihood of their race and religion. Tendency of corruption is high. Collective society and high power distance.
Technical staff	Current staff have adequate technical skills and financially able to outsource for skilled workers or the entire project.	Current staff have insufficient skill and lack of financial resources to pay for skilled workers and project outsourcing.
System design	Work practice and business processes are normally coordinated with the designed systems.	Work practice and business processes do not match with the designed systems.
Infrastructure	Good current IT infrastructure and network capabilities.	Poor current IT infrastructure and network capabilities.
Hospital distributions	Equal hospitals distribution throughout the country.	Inequity of hospitals distribution. Most hospitals are located in the urban areas.

Source: Adapted from Heeks (2002); Hong and Kim (2002); Zhang et al. (2005); Chen et al. (2006); Huang and Palvia (2001).

2.3.3 Malaysia's Standing on HIS

The Malaysian government has long emphasized the value of using Information and Communication Technology (ICT) to advance the development of the country and its economic growth. During the Sixth Malaysia Plan (1991 – 1995), emphasis was given to expanding the healthcare infrastructure. In the Seventh Malaysia Plan (1996 – 2000), ICT was considered as the enabling apparatus to support Malaysia's economic advancement. Later, in the Eight Malaysia Plan (2001 – 2005), the Telehealth flagship application was introduced. Further explanation on the Telehealth flagship is provided in the next section (see Section 2.4). Then, in the Ninth Malaysia Plan (2006 – 2010), the government strongly promoted the use of ICT in all sectors (public and private); i.e., encompassing the banking and finance sector, manufacturing sector, transportation sector, education sector and healthcare sector (Economic Planning Unit Malaysia 1991, 1996, 2001, 2006). Following the progression of Malaysian Plans, it seems that *government support* is not an issue for any shortcomings of HIS implementation in Malaysia. In fact, this indirectly answers why government support has not been raised as one of the factors influencing HIS implementation in Malaysian public hospitals.

Malaysian hospitals can be categorized as being associated with the public and the private sectors (Selvaraju 2008) and the two sectors do not have a unified system where they can exchange health information (Quek 2008). If only data could be standardized between the two sectors, this could lead to significant healthcare and medical achievements (Quek 2008). Although the current study investigated only the public hospitals domain, it is anticipated that the findings from the investigation can be used also to improve the private sector HIS implementation. One of the candidate factors that has been proposed to improve HIS implementation in the study is *business plan and vision*. It is anticipated that future HIS implementation can plan on how to merge the medical information and how to exchange the medical data so as to improve the health services in Malaysia.

Due to Malaysia's aspiration to improve its health services, HIS implementation is placed as one of the government's top priority projects. The next section describes HIS implementation projects in Malaysia.

2.4 Malaysia's HIS Implementation

In trying to become a developed nation, health services are highly prioritized in Malaysia. Accordingly, the subsequent section attempts to assist in developing understanding of the history of HIS, current HIS standing and the HIS infrastructure in Malaysia.

2.4.1 The History of HIS in Malaysia

In the early 1990s, Malaysia as a budding nation put forward a plan to become a developed country by the year 2020. This plan, later known as Vision 2020[3], was set forth by the former prime minister Tun Mahathir Mohamad; and the vision continues to be the impetus which inspires the Malaysia healthcare sector to strive for excellence. To foster this vision, in 1996, Malaysia launched the Multimedia Super Corridor (MSC) project to spur the economic growth and to attract investors to the country. The prime objective of MSC was to transform the nation's economy by means of Information and Communication Technology (ICT). Mega projects under MSC were known as *flagship* applications. Under the Telehealth flagship, the Ministry of Health (MOH) introduced the HIS to the Malaysian hospitals (Mohan and Raja Yaacob 2004).

MOH is the main health provider and financier in the public health sector and oversees the entire health system in Malaysia (Merican 2002). In fact, almost 98 percent of public medical expenses are subsidized by MOH (Ahmad 2008). Aligned with the MOH (Ministry of Health Malaysia 2010b, 1; 2010e, 1) visions to have "a nation working together for better health" and "to position Malaysia as the preferred destination for world-class healthcare services" and to be consistent with Vision 2020, Malaysia aspired to transform its health system to be the most advanced health system in the world and to improve its health delivery outcomes with the help of private health providers and non-governmental organizations (NGOs) (Ministry of Health Malaysia 1997).

The MOH-MSC Telehealth flagship applications were aimed at accelerating Malaysia's healthcare vision (Economic Planning Unit Malaysia 2001). The term

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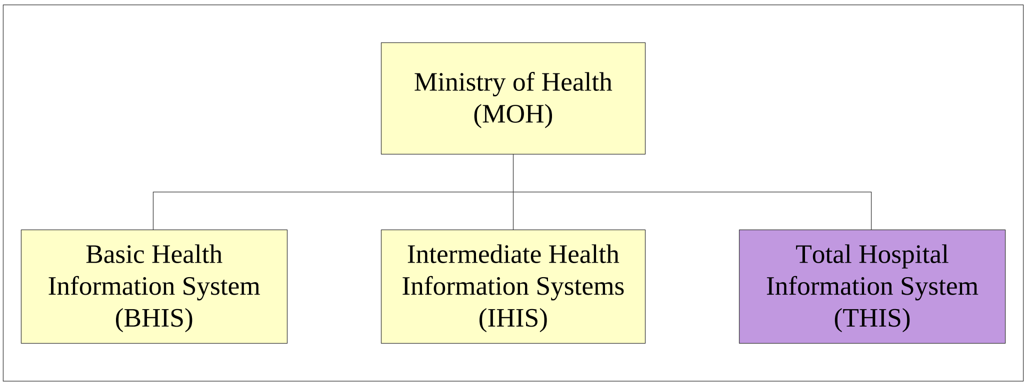
[3] Vision 2020 is the roadmap for a technologically enabled government inspired by Tun Mahathir Mohamad. It was introduced in 1991 during the Sixth Malaysia Plan. Essentially, it lays out the ground rules on how to achieve an industrialized nation by year 2020.

Telehealth refers to the integration of information, medical and health, telecommunication and human-machine interface technologies (Hisan 2010). There are four main projects under the Telehealth flagship; namely, the Lifetime Health Plan (LHP); Continuing Medical Education (CME); Mass Customized/Personalized Health Information and Education (MCPHIE); and Teleconsultation. These applications are the key projects relevant to the instigation of the HIS implementation. To narrow the scope of HIS investigation, the current study focuses only on the public health sector, where, as of 2010, MOH reported Malaysia had 130 MOH [government] hospitals. From here on, the terms 'MOH hospitals' and 'government hospitals' are used interchangeably.

2.4.2 Malaysia's HIS Infrastructure

During the Seventh Malaysia Plan (1996 - 2000), 33 hospital projects were approved for realizing HIS. Two hospitals were commissioned in 2000 and the rest are at various stages of HIS planning and development. Altogether, there should be eight hospitals with THIS and 25 small-to-medium sized hospitals with HIS.

Figure 2.4: Levels of HIS in Malaysian Public Hospitals



MOH hospitals have three levels of HIS sophistication (refer Figure 2.4). The first level is the Basic Health Information System (BHIS) which includes the Patient Management System, basic Clinical Information Systems, and financials. The second level is an Intermediate Health Information System (IHIS) that integrates BHIS and Laboratory Information System (LIS) and Pharmacy Information System (PIS). The third level is the Total Hospital Information System (THIS) which incorporates IHIS and Radiology Information System (RIS)/Picture Archiving and Communication System (PACS) and other applications (Hassan 2004; Li 2010).

In the current study, only hospitals with THIS are examined. THIS was introduced in 1999 and "aims to equip new and existing MOH hospitals with information systems and integrated Telehealth" (Li 2010, 3). THIS is a fully integrated clinical, financial and administrative information system centered on patient care (Siemens Healthcare Wordwide 2000). THIS implementation is for tertiary hospitals with over 400 beds (Hassan 2004). To date, the projected eight hospitals are confirmed as having THIS implementation (see Table 2.8). THIS are only implemented in selected tertiary hospitals located mostly in Klang Valley[4] and in the northern and southern states of Malaysia.

Table 2.8: MOH Hospitals with THIS Implementation

Hospital	Number of Beds	Source (Year)
Hospital Ampang, Selangor	562	http://hampg.moh.gov.my (2010)
Hospital Putrajaya, Wilayah Persekutuan	278	http://www.hpj.gov.my (2010)
Hospital Selayang, Selangor	852	http://hselayang.moh.gov.my (2010)
Hospital Serdang, Selangor	620	http://hserdang.moh.gov.my (2010)
Hospital Sungai Buloh, Selangor	620	http://hsgbuloh.moh.gov.my (2010)
Hospital Sultanah Bahiyah, Alor Setar, Kedah	812	http://hsbas.moh.gov.my (2010)
Hospital Sultan Abdul Halim, Sg Petani, Kedah	550	http://hsah.moh.gov.my (2010)
Hospital Sultan Ismail, Johor Bharu, Johor	704	http://hsi.moh.gov.my (2010)

Initially, Malaysia planned to have only one pilot hospital or turnkey project that would become the ideal model for future THIS hospitals. Hence, in 1999, Hospital

[4] Klang Valley is an area in Malaysia encompassing the capital city Kuala Lumpur and its suburbs.

Selayang pioneered the first THIS implementation into its daily operations (Hassan 2004). With the rising demand to ameliorate health services and facilities, in the year 2000, Hospital Putrajaya became the second hospital to integrate THIS into its operations. As a result, the initial plan to have an exemplary hospital was not executed.

A system was developed whereby hospitals selected their own vendors and HIS modules to be implemented. The Cerner product is used by Hospital Selayang and Hospital Sultan Ismail, and Hospital Putrajaya uses a product managed by Kompakar eHealth Tech Sdn Bhd. The other five hospitals which are Hospital Ampang, Hospital Sungai Buloh, Hospital Serdang, Hospital Sultanah Bahiyah, and Hospital Sultan Abdul Halim employ the iSofthealth product (Ismail et al. 2010; Ministry of Health Malaysia 2010d). Despite the differences among vendors, the success factors for HIS implementation can still be investigated. Given that the objective of the current study is to find a set of common critical success factors for HIS implementation, having different HIS products and vendors is a comparative advantage for the advancement of the study.

According to Ford et al. (2010), there are generally three strategies associated with HIS implementation; viz., single vendor, best of breed and best of suite. The main benefits of a single vendor are that the IT personnel are able to concentrate and build their expertise on a single system, the hospital is able to focus on a single vendor which makes costs management simpler and further improvements or modifications to the current system are hassle-free since a hospital is dealing with a single vendor. However, the approach has its shortcomings; e.g., inadvertently the organization limits its probability to work with other vendors, the organization may need to perform drastic transformation in cases where the vendor is unable to fulfill its promises and the organization becomes dependent on the vendor. This approach may cause the organization to suffer huge deficits because the vendor is able to maintain control and dictate future contract rates.

However, the best of breed approach integrates applications from various vendors to ensure that the hospital’s systems are state-of-the-art and meet the hospital’s requirements. Unfortunately, this approach requires a substantial amount of technical knowledge. IT personnel must be well equipped in order to manage and integrate the diverse systems. This also helps to avoid reliance on multiple vendors.

The third implementation strategy discussed by Ford et al. (2010) is known as the hybrid or ‘best of suite’ approach. Using this approach, the organization commences with one major system for example, CIS. Later, CIS is integrated with other subsystems such as LIS and PIS (refer Figure 2.5). The list of subsystems to be incorporated varies between hospitals. Even though the latter approach seems flexible, it is criticized for incurring higher costs because the main contractors or vendors impose higher charges for the cost of integrating and customizing the system.

MOH chooses ‘best of breed’ solutions rather than developing from scratch. The main reason is because MOH hospitals need to keep abreast with technology (Bulgiba 2004; Li 2010). Bulgiba (2004) asserts that Malaysia’s main problem in adopting HIS is not only caused by the complexity of HIS itself but also due to inadequate skilled resources to operate and maintain the technology; lack of experience in the use of IT in healthcare; and the attitude of health staff and practitioners. Thus, changing the mindset of health staff is considered the ultimate challenge for improving HIS implementation. Bulgiba (2004) claims have no supporting empirical evidence, but his remarks are a revelation regarding implementation problems in Malaysia. It seems that many of the identified concerns are related to people. For this reason, socio-factors are taken into account in constructing an implementation framework and collecting empirical data in the current study.

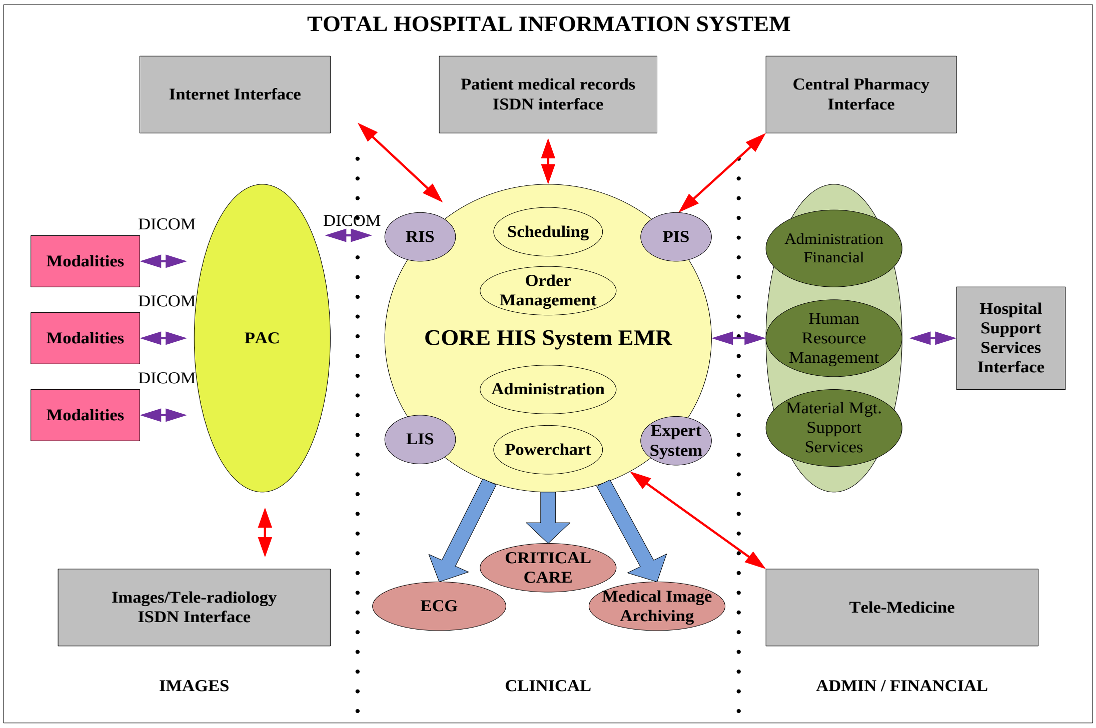
Although there are studies that attempt to identify implementation factors that influence HIS success in Malaysian hospitals, there is still a lack of empirical studies in the area. Thus, in the current study the intention is to fill the void by empirically identifying the CSFs and evaluating a success model. Addressing this gap has been the main motivation for this study. Six out of the eight nominated hospitals have been selected for the survey investigation, with hospitals chosen mainly because of their accessibility and logistic viability within the Klang Valley. It is a privilege that Hospital Sultanah Bahiyah, Alor Setar, Kedah which is located 432 km away from Kuala Lumpur is willing to participate in the survey exploration. The other two THIS hospitals, Hospital Sultan Abdul Halim, Sg Petani, Kedah and Hospital Sultan Ismail, Johor Bharu, Johor were not selected mainly due to their locality which is further away and their inclusion would have exceeded the planned budget for the study. Given that these two hospitals have the same vendor solutions as other hospitals under investigation, it is anticipated that the findings in the study can be extended to hospitals with THIS implementation in Malaysia.

Another reason for choosing THIS hospitals was due to data accessibility. In order to conduct a survey in Malaysian public hospitals, there are a number of procedures that have to be undertaken; among the procedures is to get approval from each and every director of the participating hospitals. Once hospital directors have given a written consent, an ethics application has to be put forward to MOH. Given that the number of both BHIS and IHIS type hospitals is large and they are scattered all over Malaysia, the selection of the THIS hospitals was justified. Moreover, the data collected represented 75 percent of THIS hospitals. An overview of THIS is illustrated in Figure 2.5. THIS could be regarded as a complete hospital information system that integrates the clinical, administration, financial and radiology information systems.

Figure 2.5 indicates an overview of the THIS system that integrates various hospitals' subsystems such as LIS, PIS, RIS and PAC. More detailed descriptions of the common HIS activities associated with each participating hospital can be seen in in Table 2.9.

For the purpose of analysis, data collected from the various THIS hospitals are combined. Firstly, one objective of the study was to identify the success factors for HIS implementation and it was envisaged that study findings could be generalized to all THIS implementing hospitals. Secondly, in order to perform structural equation modeling partial least squares (PLS) analyses, the minimum sample size must be 70[5]. From the collected data, only 50 to 70 respondents participated from each hospital, making it impossible to perform separate PLS analyses. Thirdly, the hospitals are governed by the same organization; viz., the Ministry of Health Malaysia. Consequently, they adhere to the same procedures, rules and policies and, for this reason, the data collected demonstrate data homogeneity.

Figure 2.5: Total Hospital Information System (THIS)



Source: Adapted from Ministry of Health Malaysia (2010c).

In this chapter it has been argued that although the vendors and products differ between hospitals, it is not unreasonable that there should be some common factors between the hospitals; factors that could be identified to enhance HIS implementation success. In addition, applying an empirical study to the HIS

[5] A complete explanation on sample size is provided in Section 4.6.2 of Chapter 4.

implementation is useful as a precursor to reporting the weaknesses and strengths of the current implementation. By combining the common success factors and the evaluation study outcomes, the researcher will be able to formulate a framework that will advance knowledge in the discipline and be useful for future HIS implementation. Although the approach is not a silver bullet for HIS implementation success, it is an idea that should not be underestimated; the strategy provides a guideline for future HIS implementation so that practitioners and researchers can learn from past mistakes and experiences. A comprehensive discussion of the implementation framework is provided in the next chapter.

2.5 Summary

In this chapter the main elements that shaped the current study have been identified and discussed. The main purpose in the study was to investigate *the critical implementation factors that influence a successful HIS implementation in Malaysian public hospitals*. In order to accomplish the research objectives, the constituents of the health information systems; studies on health system implementation in developed and developing countries; and studies on health system implementation in Malaysia must be understood. The last section in this chapter provides a comprehensive description of the Malaysian public hospitals' HIS implementation.

The following chapter builds on the information provided so far. It elaborates on the relevance of what success is, what the success dimensions are, how to measure success and its dimensions, and what causes successful implementation. In the study, HIS implementation success (henceforth HIS success) is the dependent variable and the factors affecting HIS success are the independent variables. The main emphasis in the next chapter is to explain the theoretical framework, also known as the hypothetical model, on which the research was undertaken.

Table 2.9: Hospitals with THIS Modules

Hospital Ampang	Hospital Putrajaya	Hospital Selayang	Hospital Serdang	Hospital Sungai Buloh	Hospital Sultanah Bahiyah
THIS Modules	**THIS Modules**	**THIS Modules**	**THIS Modules**	**THIS Modules**	**THIS Modules**
1. Patient Management System (PMS) 2. Medical Record (MR) 3. Clinician Access(CA) 4. Billing And Account Receivable System 5. Laboratory Information System (LIS) 6. Pharmacy Information System (PhIS) 7. Radiology Information System (RIS) 8. Mortuary Management System 9. Operating Theatre Management System (OTMS) 10. Nurse Management System 11. Dietary Management System 12. Central Sterile Supply Department (CSSD)	1. Hospital Information System 2. Electronic Medical Record (EMR) 3. Management System Sterilization Services (CSSD) 4. Dietary System 5. Pharmacy Information System (PIS) 6. Operating Theatre Management System (OTMS) 7. Staff Scheduling 8. Material Management System (MMS)/MAXIMO 9. HL/7 Engine & Interface 10. Labor & Delivery System	**Cerner** 1. Open Clinical Foundation (OCF) 2. Scheduling Management 3. Person Management 4. Order Management 5. Document Management 6. Laboratory Information System (LIS) 7. Radiology Information System (RIS) **Siemens** 1. Picture Archiving Communication System (PACS) 2. Magic View for PACS **Speedminer / Clinical Reporting** 1. Data Mining **Peoplesoft** 1. Billings & Account Receivable	1. Patient Management System (PMS) 2. Medical Record (MR) 3. Clinician Access(CA) 4. Billing And Account Receivable System 5. Laboratory Information System (LIS) 6. Pharmacy Information System (PhIS) 7. Radiology Information System (RIS) 8. Mortuary Management System 9. Operating Theatre Management System (OTMS) 10. Nurse Management System 11. Dietary Management System 12. Central Sterile Supply Department (CSSD)	1. Patient Management System (PMS) 2. Medical Record (MR) 3. Clinician Access(CA) 4. Billing And Account Receivable System 5. Laboratory Information System (LIS) 6. Pharmacy Information System (PhIS) 7. Radiology Information System (RIS) 8. Mortuary Management System 9. Operating Theatre Management System (OTMS) 10. Nurse Management System 11. Dietary Management System 12. Central Sterile Supply Department(CSSD)	1. Patient Management System (PMS) 2. Medical Record (MR) 3. Clinician Access(CA) 4. Billing And Account Receivable System 5. Laboratory Information System (LIS) 6. Pharmacy Information System (PhIS) 7. Radiology Information System (RIS) 8. Mortuary Management System 9. Operating Theatre Management System (OTMS) 10. Nurse Management System 11. Dietary Management System 12. Central Sterile Supply Department (CSSD)

Hospital Ampang	Hospital Putrajaya	Hospital Selayang	Hospital Serdang	Hospital Sungai Buloh	Hospital Sultanah Bahiyah
		Others 1. Infection Control System 2. Office Automation (OA) 3. Internet Now (Proxy)			
Clinical Sub Systems:	**Clinical Sub Systems:**	**Clinical Sub Systems:**	**Clinical Sub Systems:**	**Clinical Sub Systems:**	**Clinical Sub Systems:**
1. Picture Archiving & Communication System (PACS) 2. Cardiology PACS 3. Cardiology Management System 4. Haemodialysis System	1. Critical Care Information System (CIS) 2. Laboratory Information System (LIS) 3. Picture Archiving & Communication System (PACS) 4. Drug Database (Vendor 1) 5. Finesse Dialysis Data Acquisition and Management System : 6. Drug Database (Vendor 2) 7. Time Attendance System 8. Application Performance Management - Veritas		1. Picture Archiving & Communication System (PACS) 2. Cardiology PACS 3. Cardiology Management System 4. Haemodialysis System	1. Picture Archiving & Communication System (PACS) 2. Critical care Information System (CCIS)	1. Picture Archiving & Communication System (PACS) 2. Electro Cardiogram Management System 3. Critical Care Information System (CCIS) 4. Operating Theatre Critical Care Information System (OT CCIS)

Source: Adapted from Ministry of Health Malaysia (2010d).

Chapter 3

Theoretical Framework and Hypotheses

Since we can never know anything for sure, it is simply not worth searching for certainty; but it is well worth searching for truth; and we do this chiefly by searching for mistakes, so that we can correct them.

Popper (1902 – 1994)

3.1 Introduction

In this chapter the framework and its constituents adopted by this thesis are described. "A theoretical framework is a conceptual model for how one theorizes or makes logical sense of the relationships among the several factors that have been identified as important to the [research] problem" (Sekaran 2003, 87). Thus, Sekaran (2003) emphasizes models or theoretical frameworks to assist in clarifying associations among variables of interest, the theory underlying these relations, and the direction of the relationship. A framework serves to focus the scope, to identify the conceptual variables to be extracted and to make explicit relationship to the synthesizing question of the analysis (Kukafka et al. 2003; Williamson and Turner 2002).

In IS literature, the term *model* is considered equivalent to the term *theoretical framework* (Levy and Ellis 2006). Another label that has been associated with theoretical framework is that of conceptual framework. On the other hand, there is a difference between a conceptual and theoretical framework. A conceptual framework introduces the concepts and main thoughts of the study but not the relation between the concepts. Alternatively, a theoretical framework provides a thorough explanation of the theories underlying the framework, which includes the variables (i.e., independent, dependent, moderating, intervening variables); relations between the variables; and the constructs or latent variables of the study (Cavana, Delahaye, and Sekaran 2001). Although some scholars tend to agree that theoretical and conceptual frameworks are alike, in this thesis the researcher has chosen to use the term theoretical framework to describe the independent and dependent variables and their relationships.

Also, several hypotheses have been formulated to advocate relationships among the variables. The primary goal in this chapter is to present a workable framework for the study. The chapter begins with a description of suitable dimensions for evaluating HIS success, followed by the derivation of the candidate success factors. Next, the theoretical framework is presented. The following section discusses the hypotheses in the study. The chapter is concluded by highlighting the point that socio-factors should not be neglected in the research. Socio–factors or people factors are the most important element that must be managed to ensure a successful HIS implementation.

3.2 Deriving the Dependent Variable

A dependent variable is the main variable of interest in any research (Sekaran 2003). Alternative names for the dependent variable are criterion variable or endogenous variable. In this study, *HIS implementation success* or *HIS success* for short, is the main dependent variable. Henceforth, the two labels are used interchangeably throughout the thesis.

In the context of the study, *HIS success* refers to HIS implementation which is effective and efficient. An effective implementation occurs when the system fulfills its objectives whereas an efficient implementation happens when the HIS implementation is completed within the allocated time, effort and budget. An implementation could be effective also, but not efficient and vice versa. If this situation transpires, then other success measures must be arranged. Anticipating this type of occurrence, the study employs the DeLone and McLean (1992, 2003) success measures to assess HIS implementation in Malaysian government hospitals. The DeLone and McLean (D&M) success measures are preferred due to their broad coverage of IS success measurements.

3.2.1 HIS Success Definition

Ensuring a successful HIS implementation seems to be a challenging task for most practitioners; for this reason, many prior studies have striven to determine the best approach or best practice in implementing a successful HIS (Grol and Grimshaw 2003; Kucukyazici et al. 2008; Perleth, Jakubowski, and Busse 2001). Correspondingly, defining the constituents of a successful HIS implementation is no less complicated. It seems that *success* itself is multifaceted and difficult to be defined (Berg 2001; Markus and Tanis 2000; Seddon et al. 1999). Markus and Tanis (2000) explain that success is a subjective matter which has many dimensions that are challenging to explain. As such, Markus and Tanis (2000) define success as a *multidimensional*, *dynamic* and *relative* concept. Success is *multidimensional* when it is defined in terms of an implementation project or business result. Success is *dynamic* when what was successful yesterday may not be applicable today. In this regard, the definition of success fluctuates over time (Berg 2001; Kaplan and Shaw 2004). Success is *relative* when the meaning of success differs between different groups of users. For managers, success may mean that the project is delivered on time. For end-users, success may mean that the system provides all the functionalities, has an adequate user interface and an acceptable response time (Seddon et al. 1999).

Agreeing with the intricate and multi-dimensional phenomenon of success, a few studies assert that success is perceived differently by different stakeholders (Berg 2001; DeLone and McLean 2003; Garrity and Sanders 1998; van der Meijden et al. 2003). Berg (2001) describes successful implementation as when the system is implemented within budget and time, well accepted and used by the users to reduce medication delivery errors. In another study, success is defined as heavy use (> 80 percent) by a large number of physician users (Ash, Gorman, et al. 2003). Hebert (2001) suggests that success is when system quality is taken into consideration. Additionally, Wyatt and Spiegelhalter (1990) affirm that a system is successful when it is well accepted by clinicians. From the diverse success definitions, it is clear that success is dependent on the opinions of the stakeholders. Thus, it is vital for the current study to determine success and its measurement carefully.

In the study, HIS implementation success is defined in line with Bandara, Gable, and Rosemann (2005) where implementation is effective (i.e., the extent to which it fulfills its objectives) and efficient (i.e., the extent to which the implementation activities are completed within the allocated time and budget); and also when it conforms to the D&M IS success measurements (DeLone and McLean 1992, 2003).

3.2.2 HIS Success Measurement

IS success measurement is a topic of great interest to many IS researchers and many studies have been devoted to measuring IS success. The most influential study on IS success is by D&M (1992). They acknowledge that IS success is a multidimensional phenomenon and, therefore, classify IS success into six categories: 1) *system quality*, 2) *information quality*, 3) *use*, 4) *user satisfaction*, 5) *individual impact* and 6) *organizational impact*. D&M (1992) advise that measuring these six categories alone is debatable; in order to create a comprehensive IS success measurement instrument, researchers should consider contingent factors such as organizational, individual, task and technology factors.

In a review from 1974 until 1995 by van der Loo et al. (1995), they found that most success measures depend on the characteristics of the information systems under evaluation. Thus, it is unviable to generate a generic success measurement. A literature review performed by van der Meijden et al. (2003) from 1991 to 2001 found that the D&M IS success measurement is applicable to most patient care information systems because of its multidimensional construct; a discovery that contradicts the van der Loo et al. (1995) findings. van der Meijden et al. (2003) suggest that further research is necessary to determine the most useful attributes in measuring success and to assess different attributes for different types of patient care information systems. Further, van der Meijden et al. (2003) proposed that contingent factors such as user involvement, organizational culture, communication and training should be included in HIS success measurement.

On the other hand, Myers, Kappelman and Prybutok (1997) proposed a comprehensive IS assessment framework by integrating the work of D&M (1992) and Saunders and Jones (1992); Myers, Kappelman and Prybutok (1997) incorporated organizational and external environmental factors into the model. Many studies have followed this approach of amalgamating the D&M (1992) model with other contingent factors such as organizational, individual, task and technology factors (Jen and Chao 2008; Lee and Chung 2009; Molla and Licker 2001; Zhang et al. 2005). In a related study, Ballantine et al. (1998) took a step further by broadening the D&M (1992) model into a 3-D IS success model. Ballantine et al. (1998) segregated the IS success into three levels: 1) development, 2) deployment and 3) delivery level. Disappointingly, Ballantine et al. (1998) model has not been tested empirically due to its intricacy.

System usability aspects also must be taken into consideration when evaluating successful implementation. For this reason, Wyatt and Spiegelhalter (1990) suggest that specific questions should be raised such as whether the system is needed, acceptable response time, satisfactory interface, effective layout, and required functionalities are available. Given the relevance of the questions introduced by Wyatt and Spiegelhalter (1990), they are adopted in the study as the attributes to measure system quality. Wyatt and Spiegelhalter (1990) propose that medical systems should be evaluated in a laboratory and by field testing. Their suggestion is considered reasonable due to the fact that in any kind of evaluation, rigorous testing is useful and helpful to improve a system. In the current study only a field test has been undertaken because setting up a laboratory in Malaysian public hospitals requires countless approval processes and is both costly and time consuming.

After many critiques (Kettinger and Lee 1994; Li 1997; Pitt, Watson, and Kavan 1995) of the 1992 D&M IS success measurement model, D&M improved their model in 2003 to include the *service quality* category. They argue that IS users' support is important to ensure users' buy-in to the system and, in the current internet era, service quality includes having the website accessible at all times. In conjunction with the new category, DeLone and McLean (2003) group all the *impact* measures under a *net benefits* category. For each category, several attributes to measure success are defined; this allows the D&M IS success model to become more parsimonious.

Although there are many IS success measurement models, in the current study the D&M (1992, 2003) IS success model is adopted; it is the only IS theory that focuses on IS success as a dependent variable, considers success as a multidimensional phenomenon and incorporates the many facets of success in its model. In addition, the D&M model has been acknowledged as an important contribution to the literature on IS success measurement since it is the first study to impose some order to IS researchers' choices of success measures (Seddon et al. 1999). The D&M model also consolidates previous research on IS success, classifies IS success, recognizes the different perspective of success by the stakeholders; thus, it is considered to be suitable for further empirical and theoretical research, and meets general acceptance (Ballantine et al. 1998; Seddon et al. 1999).

In view of the D&M (1992, 2003) IS success model superiority, the model is incorporated into the theoretical framework. In the study the intent is to develop a HIS implementation framework and the D&M IS success model seems to fit the framework considering that HIS is actually a type of IS. Moreover the model has two features that are relevant to this research:

- **Acceptability:** The original D&M (1992) model has been cited in 1662 refereed papers and the modified D&M (2003) model has been cited in 984 refereed papers[6].
- **Reusability:** The measuring instruments developed by D&M (1992, 2003) can be reused to measure HIS implementation success. This helps to accelerate the development of the dependent variable instrument in the study.

[6] The number of times the paper has been cited is taken from the Scopus database accessed on Feb 29, 2012.

Table 3.1: IS Success Dimensions in Selected Health Studies

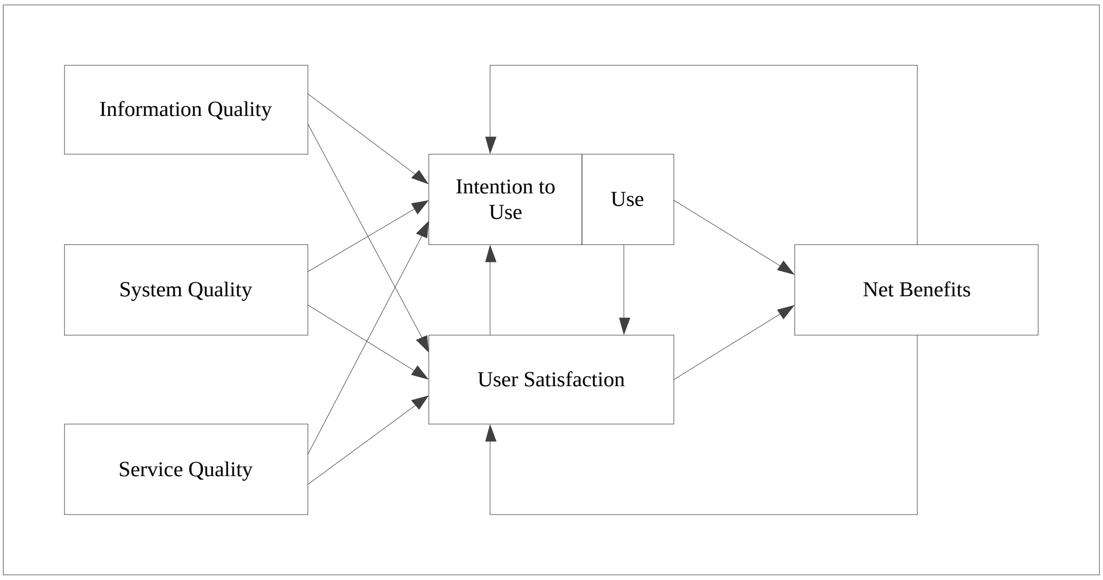
Study	Health Systems	Country	DeLone and McLean IS Success Dimension							Other Dimension
			System Quality	Information Quality	Service Quality	Use / Usage	User Satisfaction	Individual Impact	Organizational Impact	
Wyatt and Spiegelhalter (1990)	Medical Expert Systems	UK	√	√		√	√			
van der Meijden et al. (2003)	Clinical IS (CIS)	UK / NL	√	√		√	√	√	√	
Ash, Gorman, et al. (2003)	Computerized Physician Order Entry (CPOE)	USA	√	√						
Nykänen and Karimaa (2006)	Health IS	Finland	√	√		√				
Aggelidis and Chatzoglou (2008)	Hospital IS	Greece				√	√			Economic evaluation
Yusof, Kuljis, et al. (2008)	Fundus Imaging System (FIS), General Practice IS (GPIS)	UK	√	√	√	√	√	√	√	
Golob Jr et al. (2008)	Surgical Intensive Care-Infection Registry (SIC-IR)	USA	√	√			√	√	√	
Su et al. (2008)	Electronic Medical Record (EMR)	Taiwan	√		√	√	√		√	
Otieno et al. (2008)	Electronic Medical Record (EMR)	Japan	√	√	√	√	√			

Only an implemented system can be measured to determine whether or not it has been successfully implemented. For that reason, this thesis assesses only HIS systems in operation. A list of related health studies that have adopted the D&M IS success model is shown in Table 3.1.

3.2.3 HIS Success Dimensions

Detailed explanation for the attributes used in each dimension of the theoretical framework is discussed in Section 3.2.4. Prior to discussing the D&M success dimensions, an illustration of the D&M IS success model is presented in Figure 3.1.

Figure 3.1: Updated DeLone and McLean IS Success Model (2003)



Information quality denotes the quality of the provided information or the output of the information systems; it is measured by its content accuracy, reliability, completeness, precision and relevancy. Conversely, *system quality* refers to the contribution of the information systems to the end users or organization; such as the response time of the system, the recovery speed in cases of errors and the stability of the system. In this study, HIS system quality was measured by its usability, availability, reliability and response time. The third dimension of success, which is *service quality*, captures the overall support on the system itself. This new success dimension is important to promote usage among the users. If users are satisfied with the service or support that they receive, they are more likely to use the system (DeLone and McLean 1992, 2003).

The *use* construct, a most debatable dimension, indicates that to implement a system successfully, system usefulness should not be underestimated. As a result, Davis's (1986, 1989) theory of Technology Acceptance Model (TAM), which hypothesizes that *perceived usefulness* and *perceived ease-of-use* have a strong influence on user acceptance, has been adopted by many. Even though the TAM theory is well accepted, its main weaknesses is that it relies on human opinions. There is a drawback of using perceptions or expectations as unit of measurements because it is very subjective; i.e., results can differ across one individual or organization to another and they are difficult to be replicated (Markus et al. 2000).

Seddon (1997) argues that the DeLone and McLean (1992) IS success model causes much confusion due to its multiple meanings. For example, the *use* category could have triple meanings; namely, benefits from use, future IS use and as a process event leading to individual or organizational impact. To avoid confusion, Seddon (1997) extends the DeLone and McLean model by replacing the *use* category by the term *usefulness*. A new variable *user involvement* is also added to explain user perception of *usefulness* and *user satisfaction*. Correspondingly, Ives and Olson (1984) argue that *user involvement* is the key variable for success. The notion that user involvement leads to increased user satisfaction and system usage is in line with the theory of Participative Decision Making (PDM). As a consequence, Baroudi, Olson, and Ives (1986) verify this notion because they found that not only user involvement increases users' satisfaction and system usage but the more satisfied the users, the higher the system usage.

As explained by DeLone and McLean (2003, 17), *user involvement* "may cause success rather than being a part of success". They add that it is important to differentiate between an independent variable and a dependent variable in deciding the success dimensions. In this regard, the *user involvement* variable seems inappropriate for the HIS success framework. Upon assessing the validity of both D&M's (1992) and Seddon's (1997) IS success models, Rai, Lang, and Welker

(2002) conclude that both models have merit for explaining IS success. Thus, in the study, the D&M suggestion is taken into consideration. It seems that the *user involvement* variable is deemed more appropriate to become the candidate factor (independent variable) leading to a success implementation. Consequently, *user involvement* has been included under the change management and culture program measures instead of the success dimension as explained in the subsequent Section 3.3.2.

Many believe that if a system is unused the system is a failure (Amoako-Gyampah 2007; Hu et al. 1999). Given success is always perceived as the opposite of failure, many researchers feel that *system use* is an important construct. However, the notion that increased use signifies success may not be necessarily true. It could be that users have no choice since the system is the only available system in the organization. From a different perspective, many have argued that the *use*, *usefulness* or *perceived usefulness* constructs are only relevant if the system is voluntary (DeLone and McLean 1992; Seddon 1997). Unfortunately, in organizations worldwide, *system use* is mandatory. Because HIS is a mandatory system and *use* itself is difficult to be measured, the *use* construct is omitted in this study.

D&M (1992, 2003) argue that *system use* or *usage* must precede *user satisfaction* and that these two are closely interrelated (see Figure 3.1). If the users have a positive *usage* experience then this leads to increase *user satisfaction*. Likewise if *user satisfactions* are encouraging then they are more likely to *use* the system again. Nevertheless, there are some arguments on u*sage* measurement that should be noted. For example, measuring the duration of hours spent on the system is an inappropriate measure. More hours of use does not mean that the system is useful. It could mean that the system response time is slow, the interface is difficult to understand, or users may be idling on the system (Seddon 1997). Nonetheless, there are other *usage* measurements that can determine whether the user productivity has improved when using the system or the system aids the job to be performed. Therefore, the relevant *usage* measures are adopted in this study.

The *user satisfaction* construct is high among cited IS success dimensions; previous work on user satisfaction has focused on *user information satisfaction (UIS)*. Ives, Olson, and Baroudi (1983) developed a measure for UIS, which still remains significant, based on Pearson and Bailey's (1980) computer user satisfaction (CUS) measurements. Ives, Olson, and Baroudi (1983, 785) define UIS as "the extent to which users believe the information system available to them meets their information requirements". Ives, Olson, and Baroudi's (1983) main intention was to improve the reliability of early measurements on UIS. Another measurement for user satisfaction, by Doll and Torkzadeh (1988, 261) focused on *end user computing satisfaction (EUCS) and* it is defined as "the affective attitude towards a specific computer application by someone who interrelates with the application directly" and concentrates on information satisfaction measures in terms of content, ease of use, system accuracy, output format, and timeliness.

Much literature has advocated the heart of success dimensions to be *user satisfaction*. Thus, many agree that *user satisfaction* is an important measurement for IS success (Au, Ngai, and Cheng 2002; DeLone and McLean 1992, 2003; Sedera, Gable, and Chan 2003; Zhang et al. 2005). *User satisfaction* is the sum of one's positive and negative reactions towards a set of factors according to their importance. The real issue is to identify factors that contribute to the positive reaction or satisfaction and how to measure the satisfaction (Bailey and Pearson 1983). Chin and Lee (2000) stated that expectations and desires are antecedents of computing satisfaction. Nevertheless, there should be more than just expectations and desires that could contribute to user satisfaction; such as good experience with the system and simplify day-to-day activities or unintended consequences. Unintended consequences could be positive or negative consequences. In this context, it implies positive consequences.

There are many attributes or measurement items that have been proposed for *user satisfaction*, such as the notable work from Doll and Torkzadeh (Doll et al. 1995; Doll and Torkzadeh 1988; Torkzadeh and Doll 1991) and Chin and Lee (2000). However, a study conducted by Sedera and Tan (2005) suggests that *user satisfaction* is actually an overarching measure of success. After analyzing 310 responses, Sedera and Tan (2005) conclude that *user satisfaction* measures are actually composed of *system quality* and *individual impact* measures. In the current study, after further inspection of *user satisfaction* measures, these measures are placed under the *system quality* and *individual impact* measures accordingly.

As IS activities can affect many entities, from individuals to nations, the *net benefits* dimension in the study considers the success impact on individuals, work groups and organizations. Other IS impacts, such as on society, consumers, inter-organizations and industry, are not within the scope of the study. Individual and organizational impact covers how the IS implementation has influenced users and their organization. If it is a positive influence, then most likely the IS implementation is a success. D&M's (2003) prudent decision to group all the *impact* measures into *net benefit* eliminates confusion as to whether it is a good or a bad impact and also simplifies the IS success model. Agreeing that success is indeed a multifaceted phenomenon, most dimensions that have been discussed in this section are incorporated in the theoretical framework.

3.2.4 Selecting the Success Dimensions

Although the work of D&M (1992, 2003) is highly accredited for its comprehensiveness in measuring IS success, consideration must also be given to previous studies (refer Table 3.2) that have worked on IS success dimensions. IS success is a dynamic and multi-faceted entity; therefore, many researchers have tried to identify the dimensions of IS success. Table 3.2 summarizes relevant studies on IS success dimensions. It is observed that the identified dimensions on IS success are similar across most studies. Particularly, in the study, the term dimensions is used to represent the multi-faceted aspects of IS success; all these dimensions are essential but they are not sufficient conditions for success (Garrity and Sanders 1998).

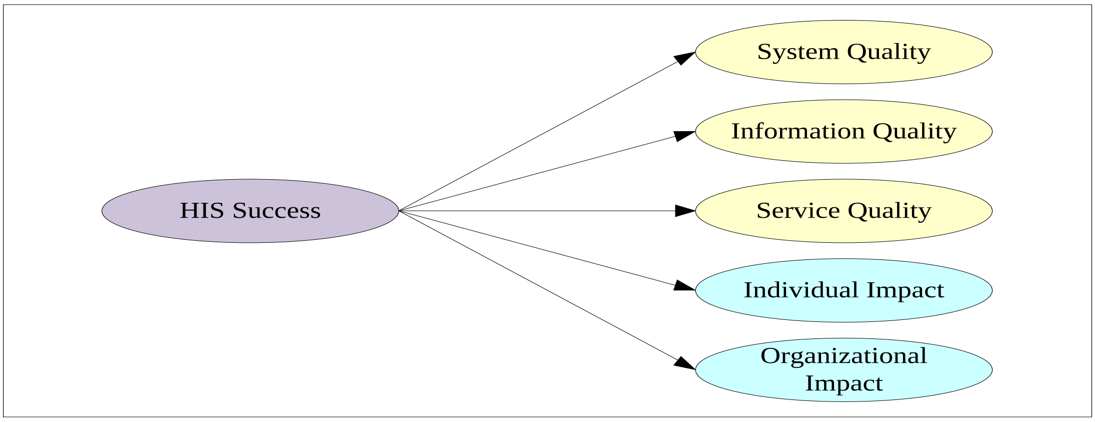
Table 3.2: Related Studies on IS Success Variables

Authors	IS Success Dimensions
Bailey and Pearson (1983)	Computer user satisfaction
Ives, Olson, and Baroudi (1983)	User information satisfaction (UIS)
Ives and Olson (1984); Baroudi, Olson, and Ives (1986)	User involvement
Doll and Torkzadeh (1988)	End-user computing satisfaction (EUCS)
DeLone and McLean (1992)	System quality, information quality, use (intention to use), user satisfaction, individual impact, organizational impact
Kettinger and Lee (1994)	Service quality
Pitt, Watson, and Kavan (1995)	System quality, information quality, service quality
Seddon and Kiew (1996)	System quality, information quality, perceived usefulness, user satisfaction
Seddon (1997)	System quality, information quality, perceived usefulness, user satisfaction, net benefits (individuals, organizations, society)
Myers, Kappelman, and Prybutok (1997)	System quality, information quality, service quality, use, user satisfaction, individual impact, workgroup impact, organizational impact
Goodhue and Thompson (1995); Garrity and Sanders (1998); Chin and Lee (2000)	User satisfaction
Wixom and Watson (2001)	Data quality, system quality, perceived net benefits
Rai, Lang, and Welker (2002)	System quality, information quality, use, user satisfaction, individual impact
DeLone and McLean (2003)	System quality, information quality, service quality, use (intention to use), user satisfaction, net benefits

From the extensive IS success-dimensions review, in the current study five success dimensions proposed by D&M's study are used as the basis of the candidate success dimensions. These dimensions are depicted in Figure 3.2. HIS success is represented as a reflective second order construct where the reflective first order constructs consist of system quality, information quality, service quality, individual impact and organizational impact[7].

[7] Explanation of reflective first order and second order construct is furnished in Section 5.4.

Figure 3.2: HIS Implementation Success Dimensions



Source: Adapted from DeLone and McLean (1992, 2003).

To reiterate, the D&M's *use* and *user satisfaction* dimensions are not used in the current study. The *use* dimension is ruled out because it is only applicable if operation of the system is voluntary (DeLone and McLean 1992). Recognizing that HIS is a mandatory system, the *use* dimension is deemed unnecessary. Upon further inspection of the user information satisfaction (UIS) and end-user computing satisfaction (EUCS) measurements, most of them seem to be part of information quality measures. Additionally, previous studies have shown that there are associations between the *quality* measures with *user satisfaction*. In the study, the same standpoint is taken as prior studies by accepting that *user satisfaction* measures are comprised essentially of system quality, information quality and individual impact measures (McGill, Hobbs, and Klobas 2003; Negash, Ryan, and Igbaria 2003; Seddon and Kiew 1996; Sedera and Tan 2005) and there is little explanatory power added (Sedera and Gable 2004). Therefore, the *user satisfaction* dimension is eliminated from the study. Figure 3.2 illustrates the candidate success dimensions used.

System quality is an important dimension in HIS success and it measures how the system behaves. Other measures for system quality include whether the system is easy to be learned and used, the response time is acceptable, the user interface is appropriate and the system is reliable, flexible and accurate. Alternatively, information quality is more concerned as to whether the delivered information is accurate and timely (acceptable response time), the report output is presentable and the output is understandable, concise and complete. Service quality that is introduced in D&M's (2003) model is also incorporated in the theoretical framework. Nowadays users are found to be demanding; they are concerned with the service or assistance that they receive when using a system. This means that if the service quality is excellent then only are they satisfied. Service quality becomes even more essential if systems have to be accessed over the internet. If the internet network is down, a contingency plan must be placed to avoid business disruption. Thus, meeting the service quality is another criterion that seems to increase user satisfaction.

In D&M's (2003) model, the impact dimensions have been amalgamated to become net benefits. Net benefits are the extent to which IS contributes to the success of individuals, groups, organizations, customers, investors, economy, finance and nations (Petter, DeLone, and McLean 2008). However, in the study, it is necessary to separate the individual and organizational impacts so that an in-depth analysis can be performed. The aim of the study is to provide guidelines for future HIS implementation; therefore, it is not sufficient to consider only the individual impact. On the other hand, the impact on customers, investors, economy, finance and others is not covered in the study due to the broad nature of the area and the difficulties of obtaining the data.

Although other studies have used perceived usefulness and perceived net benefits as part of IS success dimensions, they are not included in the theoretical framework. These dimensions are considered as behavioral beliefs while system quality, information quality and the rest of the variables chosen are considered as object-based beliefs. Empirically, there are no known issues mixing these two types of beliefs in the IS success model (Wixom and Todd 2005). They are excluded because perceived usefulness and perceived net benefits have been represented by the individual impact and organizational impact dimensions. Perceived usefulness covers all aspects of individual impact (Iivari 2005; Rai, Lang, and Welker 2002). Similarly, perceived net benefits are actually expected benefits perceived by different types of stakeholders (Seddon 1997; Wixom and Watson 2001); in this study they consist of individual and organizational dimensions.

The following section discusses the factors affecting HIS success.

3.3 Deriving the Independent Variables

An independent variable has many labels such as explanatory variable, predictor variable, or exogenous variable. However, regardless of the label, the independent variable is recognized as having a causal effect on the dependent variable, or at least influencing the dependent variable (Cavana, Delahaye, and Sekaran 2001). In this study, the critical success factors or candidate success factors form independent variables. Critical success factors in the context of the study are defined as the key areas where “things must go right” for HIS implementation success (Rockart 1979, 85). Given the lack of research work on critical success factors in the health domain (van der Meijden et al. 2003), studies from analogous domains also are explored and are described in the next section.

3.3.1 Determining the Analogous Domain for Research

In extant literature many studies have attempted to identify the success factors that could influence a successful implementation (Al-Mashari and Zairi 1999; Dezdar and Sulaiman 2009; Finney and Corbett 2007; Holland and Light 1999; Prijatelj 1999). In this study the factors from the literature are synthesized and classifications or categorizations created in order to simplify the theoretical framework and ensure comprehensiveness of the framework. It is envisaged that the new classification is able to make a contribution to the body of knowledge. Therefore, in order to compile potential factors that are required for implementation success, studies from analogous domain such as IS and ERP are utilized.

Again, it is worth mentioning that studies on critical success factors in the health domain are scarce (Malik and Khan 2009; van der Meijden et al. 2003). Therefore, the IS domain is chosen primarily because HIS emerges from this domain and because of its relevance to the study. The ERP domain, on the other hand, was selected because some HIS are actually ERP systems (Botta-Genoulaz and Millet 2006; van Merode, Groothuis, and Hasman 2004). ERP systems, or enterprise systems (ES), are defined as “configurable information systems (IS) packages that integrate information and information-based processes within and across functional areas in an organization” (Kumar and Van Hillegersberg 2000, 23). ERP systems are also defined as “comprehensive, packaged software solutions [that] seek to integrate the complete range of a business processes and functions in order to present a holistic view of the business from single information and IT architecture” (Gable, Chan, and Tan 2001, 352). Both definitions seem to describe HIS. Hence, the quest for the candidate success factors utilizes the *IS success* and *ES success* domain areas.

3.3.2 Determining the Candidate Success Factors

Both the IS and ES domains are supported by substantial literature on critical success factors. In fact, though much literature has attempted to list the CSFs, it is impossible to list a definite set of all the critical factors for a successful HIS implementation. Therefore, in the study seven candidate success factors have been classified; namely, top management and project championship, business plan and vision, enterprise-wide communication, project management, team composition, change management and culture program, and system selection and technical implementation. These candidate factors are actually a new classification inspired by the studies of Nah et al. (2006; 2007; 2001; 2003). The following sub-sections explain the candidate success factors and, in trying to make the model as comprehensive as possible, some factors have been regrouped into new categories.

3.3.2.1 Top Management and Project Championship

Research has shown that continuous top management support is crucial throughout any IS implementation project. In fact, Young and Jordan (2008) provide evidence that top management support is the most important factor in project success. Therefore, the first candidate factor, top management, is meant to address the importance of the factor. Numerous studies have supported the concept and ranked top management support highly (Akkermans and van Helden 2002; Al-Mashari, Al-Mudimigh, and Zairi 2003; Dezdar and Sulaiman 2009; Esteves and Pastor 2000; Finney and Corbett 2007; Nah, Lau, and Kuang 2001; Nah, Zuckweiler, and Lau

2003; Somers and Nelson 2001). To further investigate whether continuous top management commitment and support have a positive influence on the level of HIS success in Malaysian public hospitals, Hypothesis 1d is proposed.

The responsibilities of top management include establishing business plans and vision; setting up business goals and objectives for the organization; approving the [implementation] project; allocating budget and resources; appointing the project management team; promoting the importance and benefits of the new system via enterprise-wide communication; and justifying why the new system should be adopted (Bingi, Sharma, and Godla 1999; Holland and Light 1999; Nah, Lau, and Kuang 2001; Sumner 1999).

A report from Deloitte Consulting (2000) has revealed that Microsoft's success is contributed to top management direct involvement in planning and implementing a system. In another study, Hewlett Packard (HP) has disclosed that when HP had to undergo major transformation, the top management carefully planned and implemented the change management program (Al-Mashari, Al-Mudimigh, and Zairi 2003). These examples imply the importance of top management in the planning stage. Besides planning, a clearly defined vision is necessary for business improvement. Past research emphasized that successful visions are those that can be articulated into measurable goals (Al-Mashari, Al-Mudimigh, and Zairi 2003). Managers who set clear goals are essential for a successful implementation project (Deloitte Consulting 2000). Given the positive impact of top management on planning, Hypothesis 1a is advanced.

Project management is a factor that influences HIS implementation success; an effective project management assists in accomplishing the implementation project (Ara and Al-Mudimigh 2011; Dezdar and Sulaiman 2011a). Normally, top management define the project management infrastructure and select the project management team members (Al-Mashari, Al-Mudimigh, and Zairi 2003). A good selection is when the team members have a balanced mixture between business and technology knowledge. In HIS implementation, it is essential to include physicians as part of the project management team (Creswick and Callen 2002; Sengstack 2004).

Top management also selects a capable project manager to oversee the entire project. Considering that top management is responsible for structuring the project management team, Hypothesis 1b is established.

Communication is another factor that is critical for project success; prior research has shown that project failures are likely to occur if there is miscommunication between the parties involved in the implementation project (Akkermans and van Helden 2002; Ravesteyn and Batenburg 2010). Recent research accentuates the importance of socio-technical factors to realize implementation success (Aarts et al. 2010; Berg, Aarts, and van der Lei 2003; Kushniruk and Turner 2011). Given that the socio-technical factors involve human beings, communication is essential. The best people to promote communication are the leaders or top managers of the organization. Due to their position and authority, it is easier for them to manage any disputes among the stakeholder. To verify that top management has a positive influence on enterprise-wide communication, Hypothesis 1c is developed.

Typically, committed top manager personnel have strong leadership qualities. Dedicated leaders perform their responsibilities dutifully, and this criterion is among the critical factors for successful implementation (Sarker and Lee 2003). Prijatelj (1999, 198) concurs as shown in the argument that “the most critical determinant of success lies in the selection of the right project leader”. Prijatelj (1999) proposes that the project leader should be assigned starting from the pre-implementation phase. A study by Lorenzi and Riley (2000) also argues that leadership and change management are imperative in implementing an information system. This indicates that leadership is another success factor, as has been quoted in many research studies. Given leadership has always been associated with management; this factor has been grouped under top management.

There have been conflicting interpretations of what a project champion is. A project champion is “someone who plays a promotional, influencing role in a project” (Liu and Seddon 2009, 723) and should have a strong leadership, business, technical and personal managerial skills (Kræmmergaard and Rose 2002; Liu and Seddon 2009; Mandal and Gunasekaran 2003). Akkermans and van Helden (2002) suggest that a project champion should be the CIO or CEO or a leader from the top management group. However, other studies have described a project champion as not necessarily from the senior management. This means that a project champion can also be the project manager or an individual who promotes the benefits of IS implementation (Dezdar and Sulaiman 2009; Shanks et al. 2000; Somers and Nelson 2004). The similarity of the top management and project champion roles in being committed to the project and promoting the importance of HIS implementation justifies why project champion is grouped under the top management classification.

On the whole, the top management and project championship classification encompasses top management, leadership and project champions. Given the support, enthusiasm and commitment of top management, employees are obliged to accept the new IS implementation. The following summarizes the proposed hypotheses:

Hypothesis 1a: *Top management and project championship have a positive influence on business plan and vision.*

Hypothesis 1b: *Top management and project championship have a positive influence on project management.*

Hypothesis 1c: *Top management and project championship have a positive influence on enterprise-wide communication.*

Hypothesis 1d: *Continuous top management and project championship commitment and support have a positive influence on the level of HIS success in Malaysian public hospital.*

3.3.2.2 Business Plan and Vision

Dwight D. Eisenhower (1890 – 1969) once said, “Plans are nothing; planning is everything”. Likewise, planning is essential in HIS implementation. A clear business plan aids the organization to maintain focus on business benefits and guides ongoing organizational system implementation efforts (Dawson and Owens 2008; Dezdar and Sulaiman 2009; Nah, Lau, and Kuang 2001). Many studies have noted that a good business plan must be comprehensive and have clear defined goals and objectives (Al-Mashari, Al-Mudimigh, and Zairi 2003; Holland and Light 1999; Shanks et al. 2000). To ascertain whether a clear business plan and vision have a positive influence on the level of HIS success in Malaysian public hospital, Hypothesis 2b is established.

Also, a business plan should outline the required resources, costs, risk, objectives, measurable goals, benefits, quality, desired outcomes, timeline and deadlines for the project. These elements enable managers to progress the implementation project efficiently. (Al-Mashari, Al-Mudimigh, and Zairi 2003; Dezdar and Sulaiman 2009; Shanks et al. 2000; Wee 2000). With proper planning, even the return of investment (ROI) for HIS implementation can be justified (Chien and Tsaur 2007). To investigate whether the business plan and vision have a positive influence on project management, Hypothesis 2a is proposed.

A long-term vision and a continuous improvement strategy for the IS implementation also must be included in the business plan (Ross 1999). A proper business plan should include short- and long-term business goals. In most organizations there is always a need to establish strategic, tactical and operational planning. Strategic planning involves long-term goals such as the organization’s aspirations for the next five years. Tactical planning includes short-term goals like expected monthly or yearly revenue. Conversely, operational planning involves day-to-day tasks that need to be performed in order to achieve short-term goals (Boynton and Zmud 1984).

Prijatelj (1999) purports that the vision, business and requirements needs analysis should be done prior the implementation phase. A clear vision helps an organization to strategize its mission. Additionally, the vision needs to be communicated to all levels of the organization (Prijatelj 1999). In this study, both the business plan and vision are classified under the business plan and vision category. The following is a summary of the hypotheses:

Hypothesis 2a: Business plan and vision have a positive influence on project management.

Hypothesis 2b: A clear business plan and vision have a positive influence on the level of HIS success in Malaysian public hospital.

3.3.2.3 Enterprise-wide Communication

Communication in healthcare settings, as is similar in other industries, constitutes a critical part of the information flow. Many studies have identified effective communication throughout an implementation project as an important factor for success (Akkermans and van Helden 2002; Coiera 2000; Dezdar and Sulaiman 2011b; Nah, Islam, and Tan 2007; Ravesteyn and Batenburg 2010; Slevin and Pinto 1987). Communication is required not only between team members but across various functions and levels of the organization (Esteves and Pastor 2000). To understand the influence of enterprise-wide communication on HIS success, Hypothesis 3e is developed.

Communication is vital in project management. Through communication, the expectations and goals of the HIS implementation can be conveyed to all parties involved in the implementation project. Expectations and goals are imperative to recognize project deadlines, milestones and progress (Holland and Light 1999; Nah, Zuckweiler, and Lau 2003; Shanks et al. 2000). If the implementation project seems to be delayed, then effort could be taken to advance the progress. To verify that communication is indeed essential in project management, Hypothesis 3a is proposed.

Team functioning has a great impact on system implementation. Thus, as advocated by Rogers (1995), different types of communication (i.e., global/general communication and local/specific communication) are important for different stages of the implementation process. Additionally, a few studies have verified that effective communication can lead to effective teamwork (Druskat and Pescosolido 2002; Tesch et al. 2009). It is prudent to note that the optimal team size for effective communication is around 11 to 15 team members (Borrill et al. 2000; Gosling, Westbrook, and Braithwaite 2003). If the team is too big, it tends to form sub-groups;

communication, then, can become less efficient. To determine that communication is indispensable in team composition, Hypothesis 3b is advanced.

In an attempt to promote the newly implemented system, users' attitudes have to be transformed; thus, in any change management program, effective communication is vital. In fact, communication is one of the strategies in change management (Al-Mashari and Zairi 2000a; Aladwani 2001; Markus 2004). Through communication, the new system can be promoted to users. If there is frequent and regular communication between the organization's members, regardless of any culture differences, more benefits can be achieved. With constant communication, knowledge can be shared and propagated among the team members (Alavi and Leidner 1999). To ascertain that communication is crucial during the change management and culture program, Hypothesis 3c is proposed.

Good communication assists users to specify requirements, permits vendors to respond to requirements and allows both groups (users and vendors) to interact with each other effectively (Bostrom 1989). Consequently, all of these persons should be as part of a system selection process. Good communication is important across the selection and implementation processes. Typically, the project management and the implementation team are involved in the process. Given that both parties emphasize effective communication, inevitably this makes communication crucial in system selection and technical implementation. In addition, many studies have identified communication as being important in every aspect of implementation (Al-Mashari and Zairi 2000a; Hartman and Ashrafi 2002; Rogers 1995; Spathis and Constantinides 2003). To examine whether communication is important during the HIS selection and implementation process, Hypothesis 3d is established.

Communication must always be two-ways. Not only can the management persuade users to adopt the new system, but users too should be able to express their problems and issues about the implementation. Hence, communication becomes a medium that allows users' voices to be heard and acted on. Rosario (2000) emphasizes that users need to know that their feedback is considered in order to keep their morale high and involvement enthusiastic in the newly implemented system. Furthermore, communication must be complete and opened to ensure honesty among the employees (Holland and Light 1999; Nah, Zuckweiler, and Lau 2003; Sumner 1999). The term enterprise-wide communication signifies that effective communication is required throughout the organization.

Many studies have acknowledged that, between departments in an organization, collaboration or cooperation to the establishment and maintenance of a common goal. Therefore, enterprise-wide collaboration has been marked as another factor for successful implementation (Rai and Bajwa 1997). Without effective communication, collaboration work would not be realized. Given that both communication and cooperation are interrelated and inseparable, enterprise-wide cooperation is classified under the enterprise-wide communication category. From the above discussion, the following is a summary of the hypotheses:

Hypothesis 3a: Enterprise-wide communication has a positive influence on project management.

Hypothesis 3b: Enterprise-wide communication has a positive influence on team composition.

Hypothesis 3c: Enterprise-wide communication has a positive influence on change management and culture program.

Hypothesis 3d: Enterprise-wide communication has a positive influence on system selection and technical implementation.

Hypothesis 3e: An effective enterprise-wide communication has a positive influence on the level of HIS success in Malaysian public hospital.

3.3.2.4 Project Management

A successful project management occurs when the implementation project is well managed and meets its deadline and budget requirements (Robey, Ross, and Boudreau 2002). Therefore, an effective project management is essential in ensuring successful HIS implementation (Nah, Zuckweiler, and Lau 2003; Shanks et al. 2000). Thus, to investigate whether project management has a positive influence on the level of HIS success in Malaysian public hospitals, Hypothesis 4d is presented.

Prior studies have shown that good project management has the following characteristics: a clear and established project scope, project planning, detailed schedule, reliable plan, achievable deadlines, project completion time, project cost, assigned responsibilities to the implementation team, management of user expectations, coordination of project, visibility of implementation to users, monitoring and evaluation of performance, analysis of users' and project members' feedback and most importantly the project plan should represent the stakeholders' requirements (Al-Mashari, Al-Mudimigh, and Zairi 2003; Dezdar and Sulaiman 2009; Nah and Delgado 2006; Rosario 2000; Shanks et al. 2000).

A number of studies have demonstrated that project management is also responsible for assembling an implementation team and assigning responsibilities to the team members (Nah, Islam, and Tan 2007; Smith and Offodile 2008). A dedicated and competent team composition is desired in an implementation project (Bingi, Sharma, and Godla 1999; Rosario 2000). For this reason, project management must carefully select the implementation team members to ensure that they are proficient in areas that assist in developing the implementation project (Bingi, Sharma, and Godla 1999; Rosario 2000; Umble, Haft, and Umble 2003). Given that project managers are in-charge of the implementation team, they need to ensure that the team members are well informed on the project's status and other matters. To determine that project management has a positive influence on team composition, Hypothesis 4a is established.

The main purpose of a change management program is to motivate change and manage users' resistance to change (Grover et al. 1995). By changing the users' mindset, they become more willing to accept the system, thereby increasing system success. Ideally, project management should participate or oversee the change management and culture program. As described earlier, some project management responsibilities are to manage users' expectations and analyze users' feedback.

Hence, it is concluded that good project management can help deal with users' resistance (Al-Mashari and Zairi 2000a, 2000b). To determine that project management has a positive influence on change management and culture program, Hypothesis 4b is proposed.

A project management team should be comprised of steering committee members who are involved in the system selection process (Somers and Nelson 2004). Given that vendors also are required during the system selection process, a project management team must be able to supervise the internal and the external entities, administer the project costing [budget] and manage the implementation team members (Al-Mashari and Zairi 2000b). Thus, it is proposed that an effective project management team assists the selection of an adequate system. To investigate whether project management has a positive influence on system selection and technical implementation, Hypothesis 4c is advanced.

A competent project manager is required for managing the implementation project. Project managers should have good interpersonal skills, leadership qualities and sufficient business and technical knowledge (Nah, Islam, and Tan 2007; Shanks et al. 2000). Some studies have separated the project manager component to become a factor by itself, whereby a competent project manager is required for implementation success (Jiang, Klein, and Balloun 1996). It has become a common assumption that no management work could be done without a good project manager. Therefore, these two factors are classified under the 'project management' category. Accordingly, the following is a summary of the hypotheses proposed:

Hypothesis 4a: Project management has a positive influence on team composition.

Hypothesis 4b: Project management has a positive influence on change management and culture program.

Hypothesis 4c: Project management has a positive influence on system selection and technical implementation.

Hypothesis 4d: An effective project management has a positive influence on the level of HIS success in Malaysian public hospital.

3.3.2.5 Team Composition

HIS projects require a balanced combination of business and technical expertise. The team members such as the implementers, vendors and consultants must be competent in both areas. Much literature has emphasized team member competencies as being vital for successful implementation (Esteves and Pastor 2000; Nah and Delgado 2006; Sumner 1999). Team members should include the best people in the organization (Bingi, Sharma, and Godla 1999; Rosario 2000; Shanks et al. 2000). They should be dedicated and committed to the implementation project; thus, full-time members are preferred. The team members must have authority in making decisions that benefit the implementation project (Huang et al. 2004; Shanks et al. 2000). Some studies suggest that team members' performance must be rewarded to achieve optimal performance (Dezdar and Sulaiman 2009; Umble, Haft, and Umble 2003).

Consultants and vendors should be part of the implementation team also. Therefore, there must be some trust between users and external experts. Good interaction between the various parties of the project team is necessary since it has a direct impact on the success of the implementation (Haines and Goodhue 2000). It is advisable that the implementation team should be formed during the implementation phase (Prijatelj 1999), although some studies have separated the consultant and vendor support as another factor for successful implementation. Viewing that consultants and vendors are part of the implementation team, they are categorized under the team composition category. Thus, the following hypothesis is developed:

Hypothesis 5: A strategic team composition has a positive influence on the level of HIS success in Malaysian public hospital.

3.3.2.6 Change Management and Culture Program

Commitment to change and recognizing the need for change are very important in an IS implementation project. Thus, change management and culture program must be advocated in a system implementation project. Change management is the process of transforming individuals and organizations to its desired state (Lorenzi and Riley 2000, 2003). Much literature has determined that change is one of the core components for a successful implementation (Lorenzi and Riley 2000, 2003, 2004; Wu, Chen, and Greenes 2009).

The main constituents in change management and culture program are education and training. An organization needs to educate employees about the need for change in order to increase user acceptance and participation in the change program (Bingi, Sharma, and Godla 1999; Holland and Light 1999; Shanks et al. 2000). Education and training reduce anxieties, help end-users to gain confidence and encourage them to use the system. Furthermore, education and training should be accessible to every employee because with sufficient knowledge and information, employees are better prepared to accept new system.

Constant analysis of user feedback should be considered in the change program; this ensures that the voice of employees is heard particularly when they have problems in adapting to the new system. Hence, an effective organizational change management program must ensure continuous support is given to users. Users' comments or criticism should be addressed, since they are the people who decide whether or not to accept the newly implemented system. Thus, user acceptance is another candidate factor for implementation success.

Another significant component in a change program is user involvement (Akkermans and van Helden 2002; Al-Mashari, Al-Mudimigh, and Zairi 2003; Jeston and Nelis 2006). User involvement or user participation is vital to ensure success of the change management program. Many researchers have noted the importance of people in an organization (Deming 1986; Jeston and Nelis 2006). In fact, Ives and Olson (1984) and Baroudi, Olson, and Ives (1986) have included user involvement as one of the success dimensions.

Literature has shown organizational culture is positively related to implementation success (Ifinedo 2007, 2011; Ke and Wei 2008). Thus, a change management program must consider the cultural aspects of an organization. Nevertheless, culture has several layers such as national, regional, religious, gender, organizational and departmental culture (Hofstede, Hofstede, and Minkov 2010). In this study, only the national and organizational cultures are considered due to their appropriateness. National cultures are acquired from family, school and living surroundings whereas organizational cultures are attained when one enters the workforce (Hofstede, Hofstede, and Minkov 2010).

Accordingly, national culture is defined as patterns of thinking, feeling and acting that are embedded in the society (Nakata and Sivakumar 2001). In another definition, Hofstede, Hofstede, and Minkov (2010, 402) describe national culture as "the collective programming of the mind acquired by growing up in a particular culture". They advocate that national culture could be compared in five dimensions namely individualism-collectivism, power distance, uncertainty avoidance, masculinity-femininity and long-term orientation. Table 3.3 illustrates the definitions of all these dimensions. The score column indicates the strength of these dimensions. Malaysia is characterized as having a high power distance, weak uncertainty avoidance and high collectivism. In the current study, two Hofstede's (2010) dimensions, masculinity – femininity and long term orientation are not discussed as they do not portray the Malaysian national culture.

Table 3.3: National Culture Dimensions

National Culture Dimensions	Descriptions	Malaysian Score
Individualism-collectivism	Individualism refers to a loosely knit society where individuals are expected to look after themselves and immediate family. Collectivism stands for a tightly knit society where people are loyal to their in-group (i.e., relatives, clan).	26[a]
Power distance	The extent to which less powerful members of the institutions and organizations within a country expect and accept that power is distributed unequally.	104
Uncertainty avoidance	The extent to which the members of a culture feel threatened by uncertainty and ambiguous situations.	36
Masculinity-femininity	Gender roles are clearly distinct (e.g., men more assertive and tough; women tender and modest).	50[b]
Long-term orientation	Future oriented.	-

Note: [a] higher value indicates high individualism; [b] higher value indicates greater masculinity. Adapted from Hofstede, Hofstede, and Minkov (2010).

Organizational culture describes the norms, beliefs and values of the organizations (Stok et al. 2010) Most organizations have their own culture which develops overtime (Al-Alawi, Al-Marzooqi, and Mohammed 2007). Thus, Hofstede, Hofstede, and Minkov define organizational culture as "the collective programming of the mind that distinguishes the members of one organization from another" (Hofstede, Hofstede, and Minkov 2010, 402). McDermott and O'Dell (2001) affirm that there are two culture dimensions; the visible dimension which reflects the organization's mission and values, and the invisible dimension comprising an implicit set of core values that guide a person actions. The visible dimension is comparable to organizational culture and the invisible dimension is analogous to national culture.

Although it is challenging to change an organizational culture, especially if it has been adopted for a long time, a change management program can reduce user resistance by providing incentives or rewards to users. For example, employees who know how certain things are performed (either manually or using a legacy system), may not want to use a new system because of anxiety or fear that the new system is unable to deliver the required functionalities. This is why a change management program should promote the benefits of the new system so that users realize that it can improve their productivity and performance. Prior studies have shown that national culture influences organizational culture (Newman and Nollen 1996; Ralston et al. 1997; Van Muijen and Koopman 1994); for this reason, both organizational and national culture is referred to organizational culture in this study.

Besides culture consideration, most HIS are produced by western countries. It is normal for these products to have some aspects of embedded business flow that are not suitable for developing countries. Thus, HIS implementation becomes more challenging in developing countries because, for countries to implement and use these systems, they must be willing to accept changes (Rasmy, Tharwat, and Ashraf 2005). Managers should expect some resistance especially if the workers are not equipped with sufficient knowledge; managers must have a strategy such as a change management and culture program to encourage a strong and healthy culture among employees in order to advance the organization.

Items discussed in this section, such as commitment to change, education and training, user acceptance, user involvement, national culture and organizational culture have been classified under the 'change management and culture program' category. It is suggested that the change management and culture program should be implemented during the implementation phase (Prijatelj 1999). "The change process is not easy, but once it is accepted, users become dependent on it" (Ash, Gorman, et al. 2003, 199). With the right mold and shift of mind set in an organization, the change management and culture program could be executed successfully. From the above discussion, the following hypothesis is proposed:

Hypothesis 6: *An effective change management and culture program has a positive influence on the level of HIS success in Malaysian public hospital.*

3.3.2.7 System Selection and Technical Implementation

System selection and technical implementation (henceforth, system selection) of HIS systems must be given the utmost care and consideration. All functionalities must be met by the system to prevent reconfiguration at every stage of the system implementation. Thus, proper analysis and design are required during the system selection process (Akkermans and van Helden 2002; Nah, Zuckweiler, and Lau 2003). Additionally, Scheer and Habermann (2000) suggest that the use of appropriate implementation methodology is necessary to achieve success. However, to date, there is still a lack of methodology specifically for HIS implementation. It is acknowledged that the traditional methodology may no longer be suitable for the HIS implementation since it lacks business or organizational aspects (Ravesteyn and Batenburg 2010). At present, studies on HIS implementation methodology are still evolving.

System integration is another important aspect to be considered for successful implementation. The selected system must be able to work with the existing technology or systems without major problems. Therefore, the chosen system must go through rigorous and sophisticated testing in order to ensure a working system (Holland and Light 1999; Rosario 2000). HIS is a large and complex system; therefore, system testing is compulsory to ensure that the integrated system works well and without errors. Moreover, data errors such as incorrect medical prescriptions could be reduced drastically with adequate testing.

In selecting an information system for the hospital, attention should be given to the system that uses medical standards such as Health Level Seven (HL7), Logical Observation Identifiers Names and Codes (LOINC), and Digital Imaging and Communications in Medicine (DICOM) (McDonald et al. 1999). HL7 provides standards for exchanging clinical data; LOINC is a database and universal standard for identifying medical laboratory observations; and DICOM provides standards for handling, storing, printing and transmitting information in medical imaging. By using a common interface such as HL7, it might simplify the integration process and avoid problems during system integration (Kuhn and Giuse 2001). If possible, the selected system should only entail minimal customization. Hence, during the user requirements phase, the system specifications must be made clear to the vendors or HIS providers.

An important criterion when selecting a system is sustainability. As HIS is expensive, the system needs to be sustainable. A sustainable HIS implementation necessitates post-implementation planning; this is to allow for continuous improvement during the maintenance phase. As users become familiar with the newly implemented system, they probably have new requirements for the system. Therefore, continuous improvement planning has been identified as key factor in implementation success (Ahmad and Schroeder 2002).

Another aspect that must be considered during the selection of the HIS is the user interface. As trivial as it may sound, a good user interface design promotes human computer interaction (HCI) (Poon, Fagan, and Shortliffe 1996; Sittig, Kuperman, and Fiskio 1999) whereas a poor user interface reduces the chance of having a successfully implementation (Berg 2001). Thus, the selected system must have the desired data quality, information quality and HCI quality. The interface of the system, in addition to system quality and information quality, must be of a high standard to ensure a successful IS implementation (DeLone and McLean 1992).

The system performance and response time are also significant components during system selection (Iakovidis 1998; Tonnesen, LeMaistre, and Tucker 1999). Slow response time is absolutely unacceptable. Following D&M's (2003) suggestion that it is crucial to differentiate between the independent and dependent variable, system functionalities, integration, testing, minimal customization and plans for future improvement have been grouped under the 'system selection and technical implementation' category. This category forms one of the candidate success factors for the independent variable. Other characteristics such as good user interface, system and information quality and response time are placed under success dimensions. From the review of related literature, the following hypothesis is developed:

Hypothesis 7: *A good system selection and technical implementation have a positive influence on the level of HIS success in Malaysian public hospital.*

Table 3.4 summarizes the candidate success factors.

Table 3.4: Summary of the Candidate Success Factors

Candidate Success Factor	Description	Reference
Top management and project championship (TM)	Top managements are senior management and leaders that demonstrates strong support and commitment to the project. Project champions are leaders that have the power and abilities to promote the project to the organization, responsible of project outcome and provide feedback to senior management.	Davenport (2000b); Deghar and Kuzic (2010); Somers and Nelson (2001, 2004)
Business plan and vision (BP)	Clear vision, goals, business plan and objectives should be defined at the start of project.	Al-Mashari, Al-Mudimigh, and Zairi (2003); Somers and Nelson (2001, 2004)
Enterprise-wide communication (EC)	Disclosure of project progress to all groups involved such as the implementation team and stakeholders of the organization via emails, newsletters and other modes of communication.	Al-Mashari, Al-Mudimigh, and Zairi (2003); Gargeya and Brady (2005); Somers and Nelson (2001, 2004)
Project management (PM)	Assign responsibilities, outline project scope and milestones, coordinate activities and monitor the implementation progress effectively.	Al-Mashari, Al-Mudimigh, and Zairi (2003); Somers and Nelson (2001, 2004)
Team composition (TC)	Team members must have technical and business competence and comprise of internal (cross functional staff) and external (vendors and consultants) members.	Gargeya and Brady (2005); Shanks et al. (2000); Somers and Nelson (2001, 2004)
Change management and culture program (CM)	Activities involved include education and training. User involvements are encouraged from the design until the implementation phase.	Al-Mashari, Al-Mudimigh, and Zairi (2003); Gargeya and Brady (2005); Somers and Nelson (2001, 2004)
System selection and technical implementation (SS)	Selected system must bridge the organizational and system processes, integrates with existing systems and tested to ensure that the system fulfilled the organizations' requirements and also must be sustainable.	Gargeya and Brady (2005); Somers and Nelson (2001, 2004)

3.3.3 Moderators

Previous studies have helped in understanding the IS and HIS implementation factors. Nevertheless, past literature has reported inconsistent factors across all studies. Therefore, the moderating variables are taken into consideration in this study in order to recognize the contextual factors involved in HIS implementation. Chin, Marcolin, and Newsted (2003) suggest that the major function of moderating variables is to explain the inconsistencies of relationships between constructs by identifying situational differences. Nonetheless, Sun and Zhang (2006) caution that the inclusion of moderating variables has only a modest affect on enhancing the explanatory power of the models.

Thus, several factors are identified as moderating variables in this study. A moderating variable is a third independent variable that causes the relationship between the independent and dependent variable to change where change could be characterized as the direction and/or strength of the relationship (Cavana, Delahaye, and Sekaran 2001; Hair et al. 2010). Six moderating variables (i.e., gender, age, technology experience, project role, job position and education level) are hypothesized as noteworthy for this study.

3.3.3.1 Hypothesis Related to Gender

Often, studies in IS research have characterized specific variables such as gender, age, experience and education level as key moderating variables (Morris and Venkatesh 2000; Morris, Venkatesh, and Ackerman 2005; Venkatesh and Morris 2000; Venkatesh et al. 2003). For example, in the Venkatesh and Morris (2000) study, they found that men’s technology usage decisions differ from that of women. Men are more concerned with the system’s usefulness feature, whereas women are strongly influenced by the subjective norm and ease of use aspects. Particularly in this study, a subjective norm is defined as “the person’s perception that most people who are important to him think he should or should not perform the behavior in question” (Fishbein and Ajzen 1975, 302) or simply put, the beliefs of what others think about the person.

Studies outside the IT context, for example psychology, also have shown that gender plays a significant role (Baron and Kenny 1986; Frazier, Tix, and Barron 2004). Men are thought to be more practical and task oriented than women (Minton and Schneider 1980). In another study, Su, Rounds, and Armstrong (2009) highlight that men prefer working with things (e.g., machineries, equipment) whereas women are more people-oriented. These preferences seem to determine the occupational choices or career paths for both men and women.

Men and women are always known for their differences in thought and action. As there are claims that technology perceptions are different across genders, this study hypothesizes the following:

> *Hypothesis 8:* *Gender moderates the level of HIS implementation success in Malaysian public hospital.*

3.3.3.2 Hypothesis Related to Age

The notion that the technology domain is dominated by males is no longer true. (Morris, Venkatesh, and Ackerman 2005). Nowadays, both men and women of the younger generation seem to have the same attitude towards technology. In a study by Morris and Venkatesh (2000), they discovered that older employees, regardless of gender, are susceptible to subjective norms and are more reluctant to accept changes. Conversely, other studies indicate that age makes persons grow wiser. They become more responsible in trying to make the system work for them instead of against them (Posthuma and Campion 2009). Due to these contradicting beliefs, in this study the aim is to investigate the effect of the age variable.

Apparently, a few studies have suggested measuring both gender and age together as moderators instead of separately (Morris, Venkatesh, and Ackerman 2005). However, gender and age are measured separately in this study because the sample size is disproportionately distributed, which may limit the data analyses options. Using a separate analysis also helps to distinguish the moderating effects of the two variables. Therefore, the following hypothesis is developed:

Hypothesis 9: Age moderates the level of HIS implementation success in Malaysian public hospital.

3.3.3.3 Hypothesis Related to Level of Technology Experience

With regards to technology experience, many studies have acknowledged that experience plays an important role (Kim 2008; Venkatesh and Morris 2000). Positive outcomes are associated with increased technology experience. Technology experience is commonly measured by the number of years' involvement a user has with computers. Thus, it is not surprising that several studies have associated technology experience with self-efficacy and computer self-efficacy (Salanova et al. 2000; Salanova et al. 2003; Salanova, Peiró, and Schaufeli 2002). In this study, self-efficacy refers to the "belief in one's capabilities to organize and execute the courses of action required to manage prospective situations" (Bandura 1995, 2); whereas computer self-efficacy refers to an "individuals' beliefs about their abilities to competently use computers" (Compeau and Higgins 1995b, 189). Their studies reveal that the more technology experience one has, the higher the computer self-efficacy will be. Experience makes a person more confident with the technology in hand and reduces his or her computer anxiety. Based on the literature, the following hypothesis is proposed:

Hypothesis 10: Technology experience moderates the level of HIS implementation success in Malaysian public hospital.

3.3.3.4 Hypothesis Related to Project Role

In this study, a project role could be defined as the role that the respondents have when answering the questionnaire. There are six roles that are established in the questionnaire; viz., project champion, end-user, vendor, director, key-user and technical advisor. These roles were nominated after interviewing a few key people from the Ministry of Health, Malaysia.

Literature has shown that the concept of user roles has been studied for decades. A study by Tang and Yang (2005) reveals that different user roles may have different perceptions about certain things. For instance, in their study on web-based application, the advisors [advance users] did not pay much attention to the application's interface, communication and recommendation links as compared to regular users. This finding is significant since it proves that different groups of users do not think similarly.

In another study by Cooper (2003), the different levels of users are acknowledged. Cooper (2003) asserts that a guided system may be beneficial for novice users but the friendliness feature may not be appreciated by expert users. The needs of expert users are different. Thus, a well-designed system must have the ability to be customized. Furthermore, a social networking study revealed that users have distinct ways of presenting themselves and building up their networking (Sorensen and Skouby 2008); this implies that diverse users have dissimilar thinking.

Essentially, the findings signify that users are shaped by their roles and vice versa. Based on the literature, users' roles in the HIS implementation project are also hypothesized as influential factors for the HIS implementation success. In order to test the hypothesis, project roles are divided into two parts: expert user and end-user. The project champion, vendor, director, key-user and technical advisor roles are reclassified as 'expert user' while the 'end-user' role remains throughout the analysis. It is predicted that expert users are more determined to make the system works for them whereas end-users are more skeptical about using the system. Accordingly the following hypothesis is suggested:

Hypothesis 11: Project role moderates the level of HIS implementation success in Malaysian public hospital.

3.3.3.5 Hypothesis Related to Job Position

It is pertinent to include as many moderating variables as possible in an attempt to comprehend the complexity of the HIS implementation context. Thus, users' job positions are thought also to have some influence on HIS implementation. Some studies include job position in an effort to understand the users' profession and how it affects the IS implementation and use (Schaper and Pervan 2007b).

In this study, job position has the possibility of having three values which are managerial, non-managerial and others. Given that there must be two parts to test the hypothesis, the non-managerial and others are combined and reclassified as non-managerial; then, the final job positions which are managerial and non-managerial are tested for their moderating influence. It is believed that those who are holding the managerial positions are more enthusiastic to enhance system implementation. This belief is supported in a study from Witt (1993) who implies that those with a high ranking position have higher commitments. Thus, based on the above arguments, the following hypothesis is proposed:

Hypothesis 12: Job position moderates the level of HIS implementation success in Malaysian public hospitals.

3.3.3.6 Hypothesis Related to Level of Education

Studies have shown that respondents' education level has a positive impact on new technologies such as mobile communication technology, self-service technology and internet technology (Agarwal and Prasad 1999; Park, Yang, and Lehto 2007; Weijters et al. 2007). For industries that develop new products and technologies, education level is even more important since these industries have to release new products at a faster pace. The employees' ability to combine existing knowledge and new knowledge is essential for this type of industry (Smith, Collins, and Clark 2005).

Although respondents in this study are not required to invent new technologies, they are involved in using new technologies. Hence, it is considered that individuals with higher education levels and greater prior technology experiences are more likely to have an opinion about HIS implementation success. Based on this notion, therefore, the following hypothesis is developed:

Hypothesis 13: Education level moderates the level of HIS implementation success in Malaysian public hospitals.

Table 3.5 summarizes pertinent studies with moderating variables.

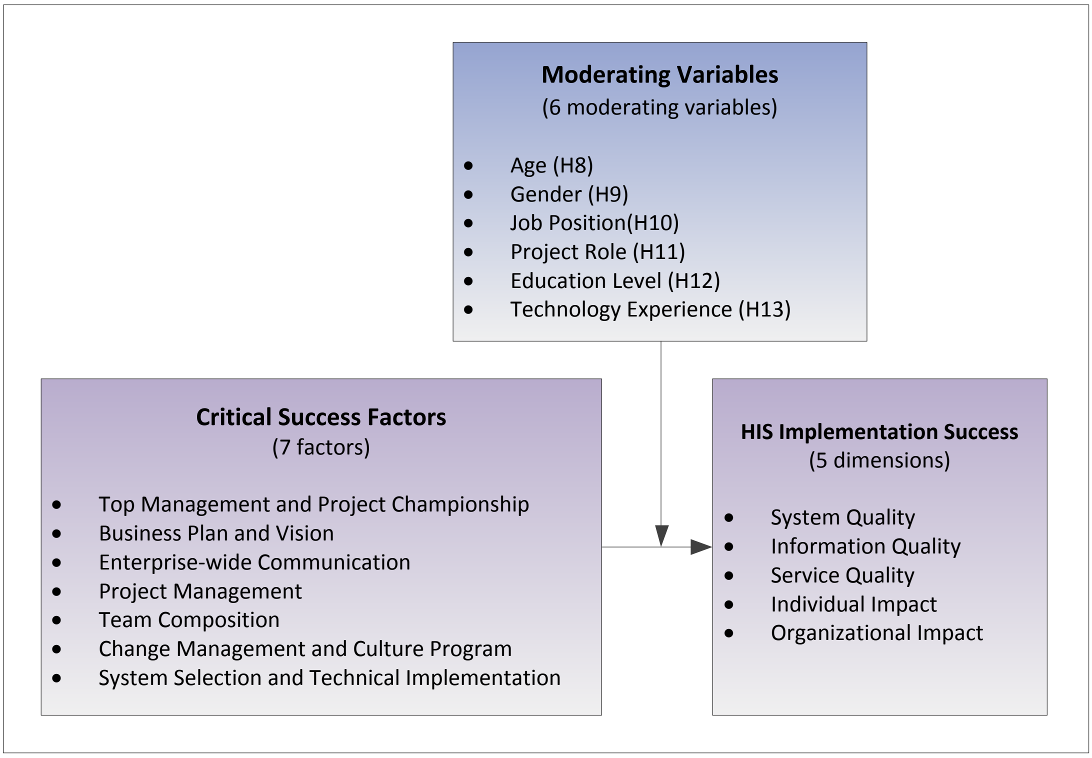
Table 3.5: Related Studies on Moderators

Study	Gender	Age	Technology Experience	Project Role	Job Position	Education Level
Witt (1993)					√	
Agarwal and Prasad (1999)						√
Morris and Venkatesh (2000)		√				
Venkatesh and Morris (2000)	√					
Salanova et al. (2000)			√			
Salanova, Peiró, and Schaufeli (2002)			√			
Salanova et al. (2003)			√			
Venkatesh et al. (2003)	√	√	√			
Cooper (2003)				√		
Tang and Yang (2005)				√		
Morris, Venkatesh, and Ackerman (2005)	√	√				
Smith, Collins, and Clark (2005)						√
Park, Yang, and Lehto (2007)						√
Weijters et al. (2007)						√
Schaper and Pervan (2007b)	√	√			√	
Posthuma and Campion (2009)		√				
Su, Rounds, and Armstrong (2009)	√					

3.4 The Derived Theoretical Framework

Accordingly, in this chapter, the constituents of the theoretical framework along with the hypotheses for this study are proposed. The candidate success factors are reclassified into seven factors in order to represent a comprehensive framework. Prior studies have tried to classify these factors into different contexts such as individual, organizational, project, technical, or implementation context (Yusof, Kuljis, et al. 2008; Zhang et al. 2005). Nevertheless, the success factors in this study have been regrouped making it difficult to distinguish separate contexts. Figure 3.3 demonstrates the conceptual framework. In its simplest form, the model implies that there are seven success factors that are purported to influence HIS implementation success. Additionally, six moderating variables are proposed as having an effect on implementation success.

Figure 3.3: The Conceptual Framework



Source: Adapted from Poon and Wagner (2001).

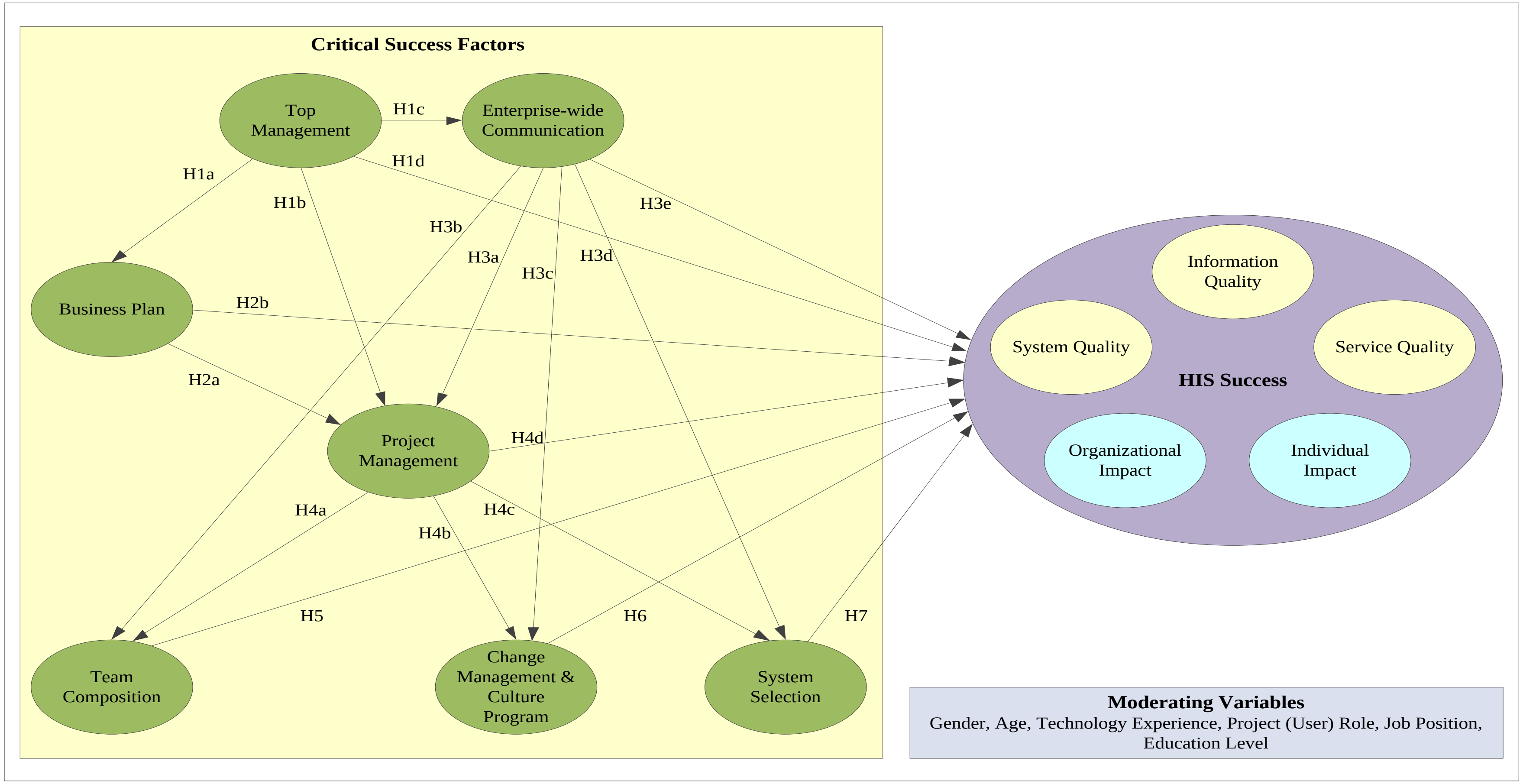
Alternatively, Figure 3.4 illustrates the detailed theoretical framework which amalgamates all the candidate success factors (exogenous variables) and the candidate success dimensions (endogenous variables). The objective of the theoretical framework is to identify the necessary determinants (candidate success factors) for a successful HIS implementation. It focuses on key variables to comprehend HIS implementation success. The arrows within the theoretical framework indicate the potential relationships between the factors. As such, 24 hypotheses are established to confirm the relationships between these factors.

From the theoretical framework, the candidate factors are demonstrated as having a positive influence on HIS success. Previously, in Section 3.2.1, it has been discussed that HIS success is made up of several dimensions. Therefore, in Figure 3.4 these dimensions are represented as system quality, information quality, service quality, individual impact and organization impact. The HIS success composition is adapted from the work of Sedera and Gable (2004). The prevalent user satisfaction dimension which is used in most IS success study, is not part of the HIS success dimensions. As explained earlier, the decision to exclude user satisfaction is because user satisfaction is an overarching measure of HIS success rather than a success dimension (Sedera and Tan 2005).

Figure 3.4 exhibits only 18 hypotheses; the other six hypotheses are meant to test the moderating influence of the demographic variables. It is pertinent to include moderating variables into the theoretical framework to explain the inconsistencies of relationships between constructs if there are any (Chin, Marcolin, and Newsted 2003). It is envisaged that the candidate success factors are able to explain more than 50 percent of HIS implementation success.

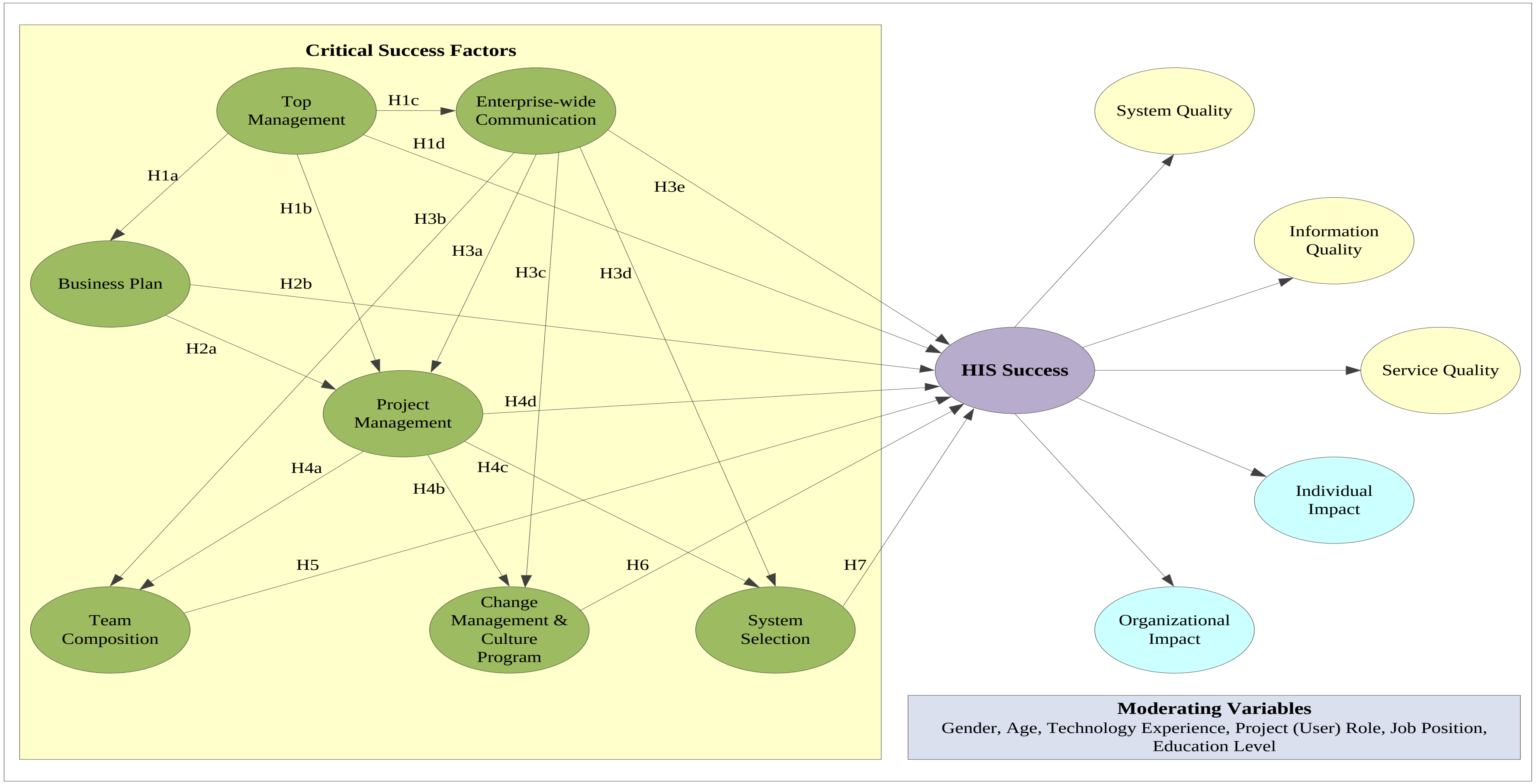
To better understand the theoretical framework, Figure 3.5 is used to demonstrate HIS success as a second order construct. As expounded in Section 3.2.4, HIS success is best represented as a reflective second order construct; the prime justification is that success in this study is measured by means of its first order constructs, namely system quality, information quality, service quality, individual impact and organizational impact (Sedera and Gable 2004). An in-depth explanation of HIS success as a second order construct is provided in Section 5.4.

Figure 3.4: The Theoretical Framework



Source: Adapted from DeLone and McLean (1992, 2003).

Figure 3.5: The Theoretical Framework with HIS Success as a Second Order Construct



Source: Adapted from Sedera and Gable (2004).

3.5 Summary of Hypotheses

In general, in the study, 13 main hypotheses have been defined to describe a total of 24 relationships to be tested for a positive influence on HIS success as depicted in Figure 3.5. A summary of the hypotheses is provided in Table 3.6.

Table 3.6: Hypotheses Summary

Hypothesis	Hypothesis Statement
Hypothesis 1a (H1a)	Top management has a positive influence on business plan and vision.
Hypothesis 1b (H1b)	Top management has a positive influence on project management.
Hypothesis 1c (H1c)	Top management has a positive influence on enterprise-wide communication.
Hypothesis 1d (H1d)	Continuous top management support and commitment has a positive influence on the level of HIS success in Malaysian public hospital.
Hypothesis 2a (H2a)	Business plan and vision has a positive influence on project management.
Hypothesis 2b (H2b)	A clear business plan and vision has a positive influence on the level of HIS success in Malaysian public hospital.
Hypothesis 3a (H3a)	Enterprise-wide communication has a positive influence on project management.
Hypothesis 3b (H3b)	Enterprise-wide communication has a positive influence on team composition.
Hypothesis 3c (H3c)	Enterprise-wide communication has a positive influence on change management and culture program
Hypothesis 3d (H3d)	Enterprise-wide communication has a positive influence on system selection and technical implementation
Hypothesis 3e (H3e)	An effective enterprise-wide communication has a positive influence on the level of HIS success in Malaysian public hospital.
Hypothesis 4a (H4a)	Project management has a positive influence on team composition.
Hypothesis 4b (H4b)	Project management has a positive influence on change management and culture program.
Hypothesis 4c (H4c)	Project management has a positive influence on system selection and technical implementation.
Hypothesis 4d (H4d)	An effective project management has a positive influence on the level of HIS success in Malaysian public hospital.
Hypothesis 5 (H5)	A strategic team composition has a positive influence on the level of HIS success in Malaysian public hospital.
Hypothesis 6 (H6)	An effective change management and culture program have a positive influence on the level of HIS success in Malaysian public hospital.
Hypothesis 7 (H7)	A good system selection and technical implementation have a positive influence on the level of HIS success in Malaysian public hospital.
Hypothesis 8 (H8)	Gender moderates the level of HIS implementation success in Malaysian public hospital.
Hypothesis 9 (H9)	Age moderates the level of HIS implementation success in Malaysian public hospital.
Hypothesis 10 (H10)	Technology experience moderates the level of HIS implementation success in Malaysian public hospital.
Hypothesis 11 (H11)	Project role moderates the level of HIS implementation success in Malaysian public hospital.
Hypothesis 12 (H12)	Job position moderates the level of HIS implementation success in Malaysian public hospital.
Hypothesis 13 (H13)	Education level moderates the level of HIS implementation success in Malaysian public hospital.

3.6 Summary

This chapter has been constructed to focus on the development of the theoretical framework for the study. Essentially, it begins by examination of a variety of IS success dimensions from previous studies and explaining the process of selecting possible success dimensions and the candidate success factors. Realizing that there could be many candidate factors, the success factors are categorized to minimize the number of factors for the theoretical framework. In total, there are seven candidate factors recognized as influencing HIS implementation success. The idea is to make the model detailed, yet simple and comprehensible. Thus, the theoretical framework is formulated by associating the candidate success factors and the success dimensions.

Prudent research should not neglect the socio-technical aspects of system implementation (Aarts, Doorewaard, and Berg 2004). Following their suggestion, the theoretical framework in this research has been constructed to include socio-technical components such as the change management and culture program and team composition. Past studies have shown that most failures are brought about by human, rather than technical, aspects. Therefore, the change management and culture program should accommodate users' involvement, provide education and training and manage users' expectations.

Based on the theoretical framework, 24 hypotheses are identified. The hypothesized relationships among the key variables are later analyzed to identify whether or not the model explains most of the variance. The results from the model assessment should be able to assist managers to focus only on the prominent success factors.

In the following Chapter 4, the research approach and the epistemology of the study are discussed.

Chapter 4
Research Approach

Each result has action steps to back them up. The action steps are like a map. If you use them like a compass you will never get lost, and you will reach your destination.
Jacqui Rivait

4.1 Introduction

In this chapter the research approach used in this study is described. It begins with an overview of the research paradigm followed by a justification of the paradigm adopted for the study. Successively, the research methodology adopted in the study is explained and the various forms of research methods are described. The research approach could be explained also in term of its processes and design; therefore, the subsequent sections describe the research process and design of the study.

4.2 Research Paradigm Positioning

The various concepts of research paradigms are provided and discussed in this section. Contrasting the different research paradigms is thought of as imperative for clarity purposes, since different researchers have their own classifications, labels and terminology for their research. This is followed by an explanation of the research paradigm adopted in this study.

4.2.1 Research Paradigm Classifications

A research paradigm is a framework that guides the conduct of research. Thus, the starting point in research design is to determine the research paradigm (Collis and Hussey 2009); paradigms also may be defined as the worldviews that guide researchers (Guba and Lincoln 1994; Plano Clark and Creswell 2008).

Research paradigms are labeled differently by different authors. For example, Creswell (2009) uses the term philosophical worldviews. Hussey and Hussey (1997) refer to it as a paradigm or philosophy. Crotty (1998), on the other hand, employs the term ‘theoretical perspective’. In this study, the term ‘research paradigm’ is used.

For Creswell (2009), there are four main research paradigms; viz., post-positivism, constructivism, advocacy/participatory and pragmatism. Conversely, Collis and Hussey (2009) divide the research paradigm into two main extremes: positivism and interpretivism. Orlikowski and Baroudi (1991) classify it into three categories, positivism, interpretivism and critical. In general, the two main research paradigms discussed in literature are positivist and interpretivist (Creswell 1994). Post-positivism and positivism frequently are associated with quantitative approaches. Accordingly, constructivism, advocacy/participatory, naturalism and interpretivism are associated often with qualitative approaches (Creswell and Clark 2007). Table 4.1 summarizes different labels of paradigms.

Table 4.1: The Two Main Research Paradigms

Positivism	Interpretivism
Realism	Idealism
Scientific	Humanism
Quantitative	Qualitative
Objectivism	Subjectivism
Traditionalism	Phenomenological
Experimentalism	Constructivism

Source: Adapted from Collis and Hussey (2009).

In deciding the philosophical stance, researchers need to be aware of the assumptions of each paradigm. In general, each paradigm could be contrasted on several dimensions based on ontology, epistemology, axiology, rhetoric, methodology, and methods (Creswell 1994; Creswell and Clark 2007; Crotty 1998; Hussey and Hussey 1997). Understanding these assumptions are important as they provide direction for designing all phases of the research study (Creswell 1994).

The ontological assumption is related to the nature of reality. Positivists believe that the social reality is objective and external to them, whereas interpretivists consider social reality as being subjective and the only way to understand it is by examining the perceptions of the individuals being investigated, hence, there should be multiple realities (Creswell 1994; Hussey and Hussey 1997).

An epistemological assumption is concerned with the relationship of the researcher to the research study (Creswell 1994). Positivist researchers should be independent of the material being researched whereas an interpretivist is fully involved with the research subjects; usually by interaction and involvement with what is being researched. Ontological and epistemological topics are closely related; hence they usually appear together. For example, if the researcher has taken an interpretivist stance then his/her belief in conducting the research concerns investigating the perceptions of the subject being researched and being personally involved in the research. On the whole, both ontological and epistemological issues describe the theoretical perspective of the researchers (Crotty 1998).

An axiological assumption is about the researcher's values in the study. For positivists, their values or beliefs are unbiased and isolated from the study; they regard the research phenomena as objects. These assumptions are commonly used in natural sciences research. However, they are less influential in social sciences research which involves people's behavior, attitudes and activities (Hussey and Hussey 1997). The latter describes the interpretivist beliefs that are influenced by what is being researched; they report the perceptions of material being researched according to their own interpretation.

A rhetorical assumption underlies the language of research; viz., an assumption which affects how the research is reported or written. Positivist researchers write in a formal style using passive voice, and apply conventional quantitative terms such as relationship and comparison. On the contrary, interpretivist researchers use an informal style with personal voice, with customary qualitative words such as discovery, understanding and meaning (Creswell 1994; Hussey and Hussey 1997).

A methodological assumption is about the entire process of the research; it covers the theoretical perspective, collection and analysis of data. The positivist process is deductive and uses measureable concepts. Hence, a large sample of data is required.

Positivist research is concerned with hypothesis testing and research results could lead to generalization and prediction, whereas interpretivist research is inductive and requires only a small sample to lead to the generating of theory.

The term 'method' refers to the technique used to gather and analyze data in regards to the research question or problem. Method is not categorized as positivist or interpretivist. Some examples of research methods are experiment, survey, content analysis, interview and observation. Table 4.2 summarizes the extreme paradigm assumptions of positivists and interpretivists.

Table 4.2: Assumptions of the Main Paradigms

Philosophical Assumption	Positivism	Interpretivism
Ontological (*What is the nature of reality?*)	• Reality is objective • Singular reality	• Reality is subjective • Multiple realities
Epistemological (*What is the relationship between the researcher and that being researched?*)	• Researcher is independent from that being researched	• Researcher interacts with that being researched
Axiological (*What is the role of values?*)	• Unbiased	• Biased
Rhetorical (*What is the language of research?*)	• Formal style • Passive voice • Accepted quantitative words • Set definitions	• Informal style • Personal voice • Accepted qualitative terms • Limited definitions
Methodological (*What is the process of research?*)	• Deductive	• Inductive
Method (*What is the technique used to gather data?*)	• Questionnaires	• Interviews • Focus groups • Observations
Features (*What are the characteristics?*)	• Quantitative data • Data is specific and precise • Large samples • Testing theories • Reliability is high • Generalize from sample to population	• Qualitative data • Data is rich and subjective • Small samples • Generating theories • Reliability is low • Generalize from one setting to another

Source: Adapted from Collis and Hussey (2009); Creswell (1994); Creswell and Clark (2007); Hussey and Hussey (1997).

The next section describes the research paradigm of the current study.

4.2.2 Thesis Research Paradigm

The study explicitly adopts the positivist research paradigm because of the ability to conform to the research purpose, theory orientation, research questions and nature of the research process. Table 4.3 recapitulates the stand for selecting the positivist approach.

Table 4.3: The Thesis Positivist Paradigm

Philosophical Assumption	Thesis Positioning
Ontological	Social reality is seen as objective and external to the researcher.
Epistemological	Researcher only plays the role as the questionnaire distributor and helps to explain whenever respondents are in doubts. The researcher did not influence respondents in any way what so ever.
Axiological	The researcher is unbiased. Proper data analysis is conducted and findings are reported accordingly.
Rhetorical	Most parts of the study use impersonal voice and quantitative wordings.
Methodological	The study is deductive where it moves from a broad topic (information systems implementation) to a more specific area (hospital systems implementation). It begins with developing theoretical hypotheses and uses empirical data to test the hypotheses. The study also adopts a cross-sectional approach intended to capture information from various respondents but within the same time frame.
Method	A self-administered survey is used as the prime source of data. The data is then analyzed using partial least square.
Summary	A positivist paradigm is adopted because of its ability to fulfill the research objectives which are: 1) to identify factors for a successful HIS implementation and 2) to determine the influence of the factors on HIS implementation. Moreover, the research requires specific data to perform hypotheses testing. From Table 4.2, the characteristics of the research fit the positivist approach.

A positivist perceives the world as external and objective, whereby inquiry is about the facts and causes of the social phenomena with very minimum emphasis on the subjective state of the individual (Collis and Hussey 2009). As the main purpose in the study is to determine factors that enhance successful HIS implementation, it is not necessary for the researcher to be involved with subjects being researched. First, it would be inaccurate if the researcher decided what the factors are. Second, only those who are involved with the HIS implementation process are able to understand and determine what the factors are. Third, the goal of the study is purely objective.

The main research question in the study is *what are the critical success factors that influence HIS implementation in Malaysia's public hospitals?* Thus, the positivist approach better explains and predicts 'what' the phenomenon is and the reason for the phenomenon's existence (Yin 2003). Accordingly, the positivist stance is required to explain the factors that contribute to implementation success. As the positivist approach is drawn from scientific belief, the approach allows the researcher to use precise quantitative data, statistics and objective measures. This enables the researcher to assess the research model for its reliability and validity, examine the explanatory power of the model, test the significance of the relationships between the factors and verify whether moderator factors influence the model. Thus, based on the purpose of the study, research question and research processes, the positivist approach is seen as the most suitable approach for the study.

In the next section, the research methodology of the study is discussed.

4.3 Research Methodology

Collis and Hussey (2009) define a methodology as an approach to the research process consisting multiple methods, whereas Crotty (1998, 3) defines methodology as "the strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and use of methods to the desired outcomes". Basically a research methodology is the strategy on how the research problem is tackled and choosing a suitable research methodology is crucial for the success of the research (Creswell 2009). Nonetheless, the research methodology must adhere to the research paradigm selected. Some examples of methodologies used in research are listed in Table 4.4.

Table 4.4: Methodologies Associated with the Two Main Paradigms

Positivism	Interpretivism
Experimental studies	Case studies
Surveys (using primary or secondary data)	Grounded theory
Cross-sectional studies	Participative enquiry (interviews)
Longitudinal studies	Action research

Source: Adapted from Collis and Hussey (2009).

Given the positivist approach is adopted for the study, the following explains only the positivist methodology.

4.3.1 Experimental Research

Experimental research attempts to determine if a specific treatment or intervention influences an outcome (Creswell 2009). Typically this type of research consists of two groups, where one group is introduced to the treatment while the other group serves as a control group. The impact of the treatment is then assessed by quantitative analysis techniques. There are two types of experimental research:

1) Laboratory experiment – the advantage of a laboratory experiment is that researchers have considerable control over the environment, where the effect of confounding or extraneous variables can be controlled. Nevertheless, experimental research fails to reflect the reality.
2) Field (natural) experiment – the advantage of this experiment is that the research is conducted in a natural setting which is more realistic. However, researchers have less control over the environment.

4.3.2 Survey Research

Unlike experimental research, the survey research involves collecting primary or secondary data from a sample of the population. The data is then statistically analyzed and the results are generalized from the population (Collis and Hussey 2009). The two types of survey research are:

1) Descriptive survey – the main purpose of the survey is to describe an accurate representation of the phenomena at a particular point in time or at various points in time.
2) Analytical survey – used to test whether there are any relationships between the independent and dependent variables. For an analytical survey, it is suggested that a theoretical framework be developed first.

Both types of survey can be conducted in a cross-sectional or a longitudinal study. Cross-sectional studies are designed to collect data over the same period of time whereas longitudinal studies involve repeated observations at different points in time. Thus, a cross-sectional study typically is chosen if there are time constraints or limited resources (Collis and Hussey 2009).

4.3.3 Thesis Research Methodology

In deciding between the two positivist methodologies, consideration is made on the purpose of the study and whether the methodology addresses the research problem. Accordingly, Yin's (2003) recommendations (see Table 4.5) had been used as a guideline in selecting the appropriate research methodology.

Table 4.5: The Positivist Methodologies

Methodology	**Form of Research Question**	**Requires Controlled Environment?**	**Focuses on Contemporary Events?**
Experimental	how, why?	Yes	Yes
Survey	who, what, where, how many, how much?	No	Yes

Source: Adapted from Yin (2003).

The research question in this study focuses on the 'what' question, requires no controlled environment and focuses on the current situation. Therefore, the most suitable methodology for the study, among those suggested by Yin (2003) is the survey methodology. It is considered that this approach can expose the factors that influence HIS implementation success in Malaysia. The analytical survey is most appropriate because one of the objectives in the study is to test for relationships between the independent and dependent variables.

The survey approach also allows the researcher to collect responses within a reasonable period of time and it is cost effective (Sekaran 2003). The approach not only provides quantitative description of views, trends or stance but also allows generalization to the population (Creswell 2009). Part of the objective in the study is to gather the opinions of HIS users, implementers, and maintainers on the potential factors that could influence HIS implementation success; a task that must be performed within a reasonable time so as not to exceed the budget or the period of study. It would be an advantage if the results of the analysis from the study could be generalized to other HIS implementation. Thus, the survey approach seems most appropriate.

The survey research is known to be widely used in IS for several reasons. First, the survey research allows data to be analyzed at both individual and aggregated levels. Second, it allows rigorous hypotheses testing and generalization given more samples cases (Danziger and Kraemer 1991). Third, it has the potential to add to the inventory of previously well-developed research instruments (Ishman 1998) and lastly, it is useful to document the norm, identify extreme outcomes and describe relationships between the variables (Attewell and Rule 1991). All of these advantages appear to fit the objectives of the study, thereby supporting the research approach decision.

Additionally, prior studies investigating information systems implementation have been reviewed; Table 4.6 illustrates the research methodology adopted by these studies. The survey research methodology appears to be the most accepted methodology, again justifying its adoption in this study.

Table 4.6: Research Methodologies used in Related IS Implementation Studies

Study	Description	Methodology	Sample Size	Return Rate
Frantz, Southerland, and Johnson (2002)	Determine the similarities and differences in CFOs' and CIOs' perceptions of best practices for ERP implementations.	Mail survey of chief financial and information officers (CFO and CIO) at 170 institutions accredited by the Southern Association of Colleges and Schools, USA.	308	53.0 %
Hong and Kim (2002)	Explores the main cause for ERP implementation failures.	Field survey on 34 organizations.	106	30.3 %
Petroni (2002)	Identify the factors of MRP implementation to ensure successful implementation.	Postal survey on small and medium (SMEs) manufacturing firms in northern Italy	109	N/A
Nah, Zuckweiler, and Lau (2003)	Determine CIOs' perceptions of the top five critical factors.	Mail survey of CIOs from Fortune 1000 companies in USA.	N/A	76 responses
Somers and Nelson (2004)	Analyze the important key players and activities throughout ERP implementation stages.	Mail survey to Fortune 500 firms and a random sample of 200 organizations in USA.	700	19.0 %
Ehie and Madsen (2005)	Identify critical issues in ERP implementation	Mail survey to companies in Midwestern region of the USA.	200	18 %
Kim, Lee, and Gosain (2005)	Classify critical impediments in ERP implementations and its impact on success.	Survey of IT managers from Fortune 500 organizations in USA.	N/A	14.6 %
Karimi, Somers, and Bhattacherjee (2007)	Ascertain the extent of ERP implementation influences on the business process outcome by incorporating the innovation diffusion theory.	Mail survey to USA manufacturing firms.	550	27.0 %
Tsai et al. (2007)	Explore relationship between implementation variables and performance improvement of ERP systems.	Stage 1: Sample survey to list the importance of performance measurements for each D&M model dimensions.	260	17.3 %
		Stage 2: The top five performance measures from Stage 1 were distributed to manufacturing and services industries listed in the TOP 5000 Largest Corporations in Taiwan.	3597	18.3 %
Zabjek, Kovacic, and Stemberger (2009)	Investigate the impact of business process management (BPM) and CSFs on successful ERP implementations.	Survey on Slovenian companies with more than 50 employees.	600	25.3 %

Note: Majority of IS implementation studies adopt the case study approach (Bansler and Havn 2010; Øvretveit et al. 2007a; Trimmer, Pumphrey, and Wiggins 2002; Tsai et al. 2009; Zhang et al. 2005).

There are several methods of data collection that could be used for the survey research methodology, such as mail questionnaires, internet questionnaires, self-administered questionnaires, or telephone interviews. For this study, a cross-sectional survey and self-administered questionnaire design is employed. The next section describes the research method in detail.

4.4 Research Method

Apart from the research paradigm and methodology, research method is another major component in the research approach; it specifies the forms of data collection, analysis and interpretation (Creswell 2009). With regards to survey research, the forms of data collection are questionnaires, interviews and observations. The choice of methods is largely governed by the purpose of the study, time constraints, available budget and resources. It is also important to understand that each method has weaknesses and strengths, so that the method's bias can be addressed (Cavana, Delahaye, and Sekaran 2001). Table 4.7 summarizes various data collection methods capabilities.

Table 4.7: Data Collection Capabilities

Data Collection Techniques	Coverage	Response Rate	Cost	Labor	Speed	Expertise to Construct
Personal interviews	Low	High	High	Low	High	High
Telephone interviews	High	Medium	Low	Medium	High	Low
Self-administered questionnaires	Low	High	High	Low	Low – medium	Low
Mail questionnaires	High	Low	High	High	Low	Low
Internet questionnaires	High	Low	Low	Low	High	High

Source: Adapted from Cavana, Delahaye, and Sekaran (2001) and Zikmund (2003).

Although personal interviews provide rich data, an opportunity to establish rapport, and clarify respondent's doubts on the research topic, the method also has several disadvantages. The major disadvantage is the potential for interviewer bias where respondents may not be totally honest with their answers. Therefore, the technique is suitable in the early stage of the data gathering process where the main purpose is to seek an understanding of the research concepts.

Telephone interviews, on the other hand, are less costly than personal interviews and they provide faster responses while providing broader coverage area. Nonetheless, they have the potential of a low response rate since interviewees may block or decline to answer the calls. Moreover, respondents cannot be observed for non-verbal responses. However, the technique is useful for structured questionnaires where the response is short and precise. With regards to the self-administered questionnaire, its strengths are similar to personal interviews with the opportunity to collect the questionnaires immediately after they have been completed. However, the technique is expensive when the respondents are geographically dispersed.

The mail questionnaires method is also a type of self-administered questionnaire, useful when data has to be collected from a wide coverage area. However, the method has a low response rate since respondents may not return their answers to the researcher. Additionally, it is expensive since it involves the costs of postage, photocopying and labor. The method is also laborious since envelopes have to be labeled and questionnaires need folding and putting into envelopes, preparing return envelopes, and follow-up telephone calls or reminders for non-responses. Another problem is the time factor. Due to the slowness and the time constraint of this technique, the method is seen as not feasible.

Conversely, internet questionnaires are much cheaper than mail questionnaires since they require only a one-time setup. However, the method also has a low response rate since not everyone is computer literate or has internet access; also, respondents must complete the entire survey or else their responses might be deemed invalid. In some cases with missing data, the software packages would not allow respondents to proceed.

Analyzing the various forms of data collection, the self-administered technique was chosen over other data collection methods because of its high response rate. Judging from the current situation in hospitals, it is most unlikely to get back the questionnaires if they are sent by mail. A logical explanation could be that due to their work ethic and obligations, hospital staff feel they need to prioritize their work rather than answer questionnaires. Therefore, it is possible that hospital employees may forget to return the questionnaire or totally ignore it due to their hectic workloads. The internet questionnaires method is also not an option since hospital employee respondents are known to have limited access to the internet. The self-administered technique is also preferred because it establishes rapport and motivates respondents while their doubts can be clarified immediately. It is also less expensive when it is administered to groups of respondents and almost 100 percent response rate is ensured while the anonymity of the respondent is high (Sekaran 2003).

As the questionnaire is long, the self-administered drop-off method was adopted as suggested by Zikmund (2003). The questionnaire was dropped off at the respective hospitals and collected upon completion. The questionnaire collection dates differed between hospitals as agreed with a contact person from each hospital. The only drawback of this method is it involves extra traveling costs to the various locations.

In trying to increase the response rates for the survey research, some of Zikmund's (2003) suggestions were followed in order to achieve the desired results; this included providing cover letters to the respondents to outline the intention of the questionnaire and ensuring confidentiality and anonymity. Incentives such as souvenirs were also allocated in order to maximize the response rate. Another strategy was to do follow-up telephone calls and preliminary notification; research has shown that if the respondents are contacted multiple times, there is an increased likelihood of them responding to the questionnaire (Schaefer and Dillman 1998).

4.5 Research Process

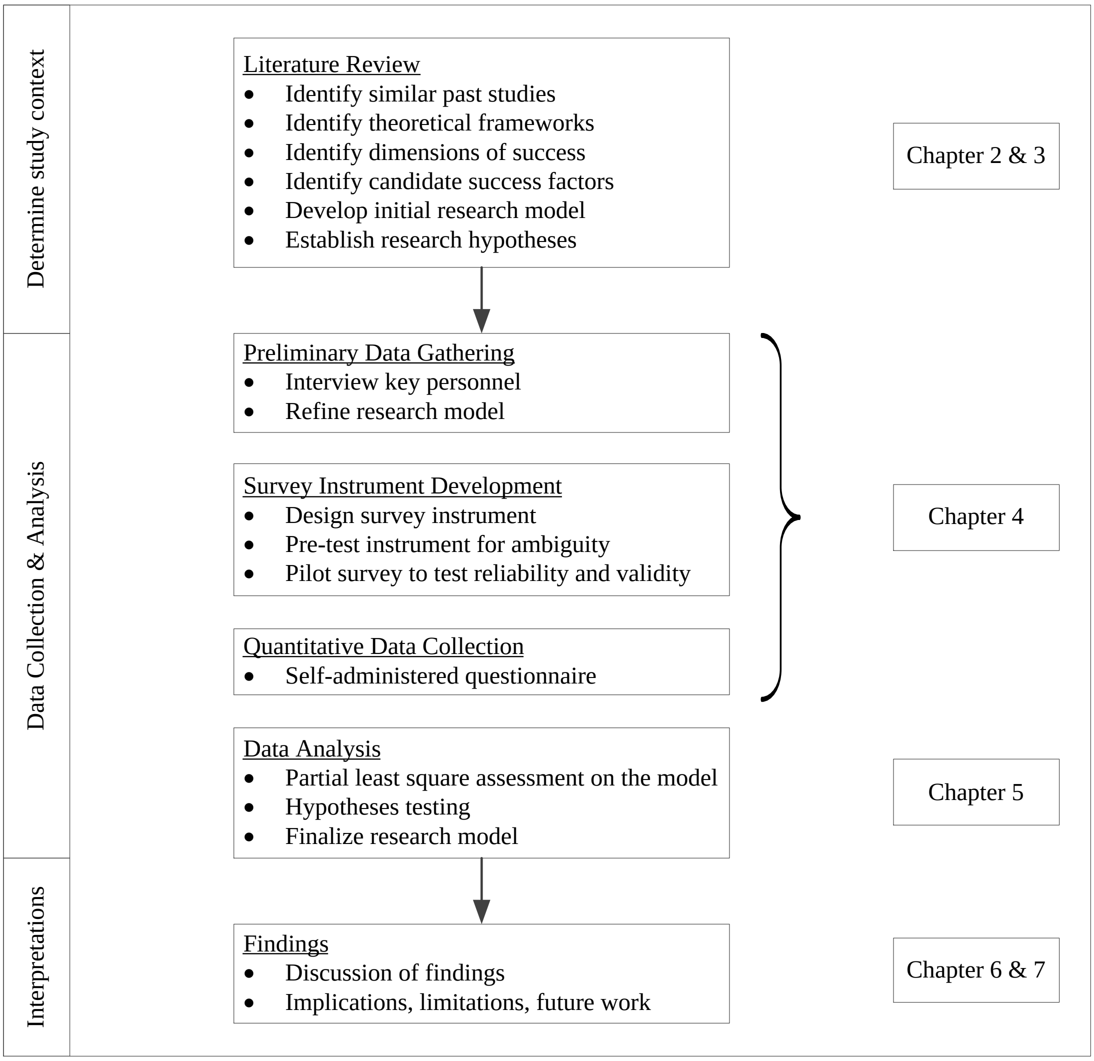
The research process has several phases beginning with the research problem formulation through to interpretation of the results. Once the research problem has been defined, the research design must be developed (Zikmund 2003). A research design provides the planning for the actual study from sample selection, data collection and data analysis (Sekaran 2003). The research design for this study is elaborated in Section 4.6.

Figure 4.1 provides the outline of the research process, starting with a review of the related literature. In this phase, issues, gaps, potential key variables and theories regarding HIS implementation were explored until the researcher decided on the research problem. Based on the review of the literature, an initial theoretical framework (research model) and hypotheses were developed as explained in Chapter 3 (Section 3.4); the main purpose of the theoretical framework being to highlight the potential key variables and their associations.

Following the development of hypotheses, a series of interviews with potential respondents was conducted. The main aim in the interviews was to identify the relevancy and appropriateness of the implementation factors obtained from the literature, especially in the context of Malaysian public hospitals. Next, the survey instrument was developed. At this phase, the measurement items (indicators) of the latent constructs were established from the literature as well as from the interview responses. The survey instrument was then pre-tested to ensure that respondents could understand the questionnaire and to find out whether there were any biased or ambiguous questions. Subsequently, a pilot study was conducted to ensure that the instrument was reliable and valid. The finalized instrument was distributed then to the research participants. This process is labeled as the Quantitative Data Collection as shown in Figure 4.1.

Once data had been collected, the structural equation model component-based approach was used for analyzing the data. An overview of this statistical technique is provided in Chapter 5 (Section 5.4). At this phase, the research model was evaluated and the hypotheses were tested. This was followed by the interpretation and discussion of the findings which is presented in Chapter 6. Lastly, in the final phase of the research process, the implications, limitations and possibilities for future research are reported.

Figure 4.1: Overview of the Research Process



4.6 Research Design

Research designs are plans and procedures on how to conduct a systematic and organized investigation; the plan consists from broad assumptions to detailed methods of data collection and analysis (Creswell 2009). Prior to designing the research, the research paradigm must be established because it influences the choice of the research problem, questions and methods for collecting and analyzing the data. It is recognized that sometimes during the research process, the research paradigm has to be reviewed in order to satisfy the research problem; at other times, the research problem has to be refined. Thus, the first step in the research design is to identify the research problem. Upon much consideration of the research problem, in this study a positivist stance was selected. The following sub-sections discuss the research design adopted for the study.

4.6.1 Unit of Analysis

The unit of analysis refers to the level of aggregation of the data collected and is determined by the research problem statement (Cavana, Delahaye, and Sekaran 2001). For example, if the research problem is to find ways to increase employees' productivity then the unit of analysis would be the individual. In this study, the unit of analysis is the organization level because the research problem is to identify factors that could influence HIS implementation success for public hospitals in Malaysia.

4.6.2 Sample Selection

For this study, the population consists of all government hospital employees who are HIS users, implementers and maintenance personnel. The estimated number of population was in the thousands[8]. Therefore, six out of eight government hospitals which had implemented THIS were selected for the study in order to get standardized data since most hospitals have a different level of HIS implementation, as explained in Chapter 2.

Conversely, sampling is the process of selecting a sufficient number of elements from the population to allow generalization of the sample characteristics to the population (Sekaran 2003). The importance of sampling is obvious in that, with an abundance of data, it would be impractical to collect data from the entire population. Even if it is possible, other factors such as cost, time, labor and other resources must

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[8] As in 2010, there are 130 government hospitals in Malaysia. Each hospital has more than 100 employees.

also be well thought-out. The sampling technique is used to produce reliable results because fewer errors could occur.

Sampling designs can be divided into two types: 1) probability sampling and 2) non-probability sampling. The former is used when the representativeness of the sample is crucial for generalizability and when the elements of the population have an equal chance of being chosen as subjects in the research (Cavana, Delahaye, and Sekaran 2001). Alternatively, non-probability is chosen when factors other than generalizability are desired. Given the intention in this study is to generalize the findings to other Malaysian hospitals, the probability sampling approach was chosen.

For the sample size, it is well-accepted that the larger the sample, the better it will represent the population; then again, if the sample size is too large, any statistical test can be significant (Hair et al. 2010). Selecting the ideal sample size depends on the intention of the researcher (Collis and Hussey 2009), the size of the target population (Dillman 2000), as well as cost and time (Newton and Rudestam 1999). Statistical techniques using covariance-based and variance-based structural equation modeling (SEM) require even larger sample sizes because certain SEM software "are unreliable with small samples" (Hair et al. 2010, 661).

The variance-based, also called component-based SEM, analysis is applied in this study[9]; this type of analysis suggests that the sample size should be either 10 times the number of items in the most complex formative construct (Chin 1998b) or the largest number of independent variables impacting a dependent variable, whichever is greater (Barclay, Higgins, and Thompson 1995). In Figure 3.5 of Chapter 3, the most complex construct is HIS success, which has seven constructs associated with the construct. Accordingly, the minimum sample size to enable data analysis using the component-based SEM statistical technique in this study is 70 responses.

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[9] Justification for selecting the component-based SEM is given in Section 4.6.5 of this chapter and in Section 5.4 of Chapter 5.

4.6.3 Survey Instrument Development

It has been noted that the main mode of data collection is the self-administered questionnaire approach and the aim in the questionnaire is to collect data pertaining to the constructs identified in the research model. Zmud and Boynton (1991, 154) state that "one should never develop an instrument from scratch when a well-developed, or fairly well-developed instrument that fits the level of analysis and level of detail required by a particular research model already exist". Hence, the survey instrument developed for this research was mainly based on material analyzed during the review of the literature. The self-reporting approach was not without its limitations; however, it had been employed to collect a large amount of data for statistical testing of relationships at a relatively low cost. The limitations of self-reporting are discussed further in Chapter 7 (Section 7.5).

As advocated by Fowler (2009), the questionnaire had been structured into three main sections. Each section contains a particular order of questions to ensure a consistent flow. Table 4.8 illustrates the questionnaire structure.

Table 4.8: Questionnaire Sections

Section	Description
A	Demographic information
B	Critical success factors of IS implementation
C	Success measures for IS implementation

4.6.3.1 Constructs Measurements

In the study, the HIS implementation success construct, the main dependent variable, is represented by the dimensions of IS success. The IS success dimensions are comprised of system quality, information quality, service quality, individual impact, and organizational impact. For each dimension, also called a sub-construct, the measurement items developed were adapted from previous research. The items were worded according to the needs of the study and for the purpose of improving face validity. Table 4.9 lists the measuring items adapted for HIS implementation success.

Table 4.9: Measuring Items for HIS Success

Sub-construct	Measurement Items	References
System quality	• The IT system is easy to use. • The IT system is user friendly. • The IT system is easy to learn. • I find it easy to get the system to do what I want it to do. • The response and turnaround time of the IT system is acceptable. • The IT system is reliable. • The IT system is stable. • The system is fast to recover from errors. • The system is convenience to use. • The system can communicate sufficiently with other information systems. • I am satisfied with the IT system efficiency. • I am satisfied with the IT system effectiveness.	DeLone and McLean (1992, 2003); Seddon and Kiew (1996)
Information quality	• The information output is presented in a useful format. • The information provided seem to be the precise information I need. • The information provided is accurate and reliable. • I am satisfied with the accuracy of the system. • The information provided is relevant and useful for my work. • The information provided is clear and understandable. • The information provided is complete. • The information provided is sufficient. • The information provided is consistent. • The information provided is up-to-date information. • The information provided is timely. • The IT system meets my information process needs.	DeLone and McLean (1992, 2003); Seddon and Kiew (1996)
Service quality	• Provide prompt service to users. • Have the knowledge to do their jobs well. • Are always willing to help. • Deliver when they promise to do something.. • Show sincere interest in solving problems encountered by myself or others in my work group. • Understand my needs and those of my work group. • Provide me individual attention. • Provide follow-up service to users. • Provide assurance to solve problems. • Are consistently courteous with users.	DeLone and McLean (1992, 2003); Seddon and Kiew (1996)

Sub-construct	Measurement Items	References
Individual impact	• Using the system in my job enables me to accomplish tasks faster. • Using the system saves time. • Using the system improves my job performance. • Using the system in my job increases my productivity. • Using the system enhances my effectiveness in my job. • Using the system makes it easier to complete my job. • I find the system is useful in my job. • Using the system enhances my awareness and recall of job related information. • I learn a lot through the presence of the system. • Overall, I am satisfied with the IT system.	DeLone and McLean (1992, 2003); Seddon and Kiew (1996)
Organizational impact	• Capacity planning, cost estimation and inventory control have improved. • The system has resulted in overall productivity improvement. • The system has resulted in an increased capacity to manage a growing volume of activity. • The system has resulted in improved business process. • There is a reduction in informal systems for hospitals. • There is a reduction of operating cost. • Cooperation between various departments within the organization has improved (e.g., finance, human resource, and operations). • Employee job satisfaction and morale has improved. • The system improves communication efficiency. • The system improves the quality of service.	DeLone and McLean (1992, 2003); Seddon and Kiew (1996)

The first sub-construct, system quality, measures the desired characteristics of the system. Alternatively, information quality concerns the information provided by the system such as precision, sufficiency and timeliness of the information. The service quality is the overall support from the IT department or external provider or internet service provider. D&M (2003) assert that system quality and information quality are the most important quality components to measure the success of a single system. Conversely, service quality would be the most important construct to measure the success of a complete system instead of part of a system. The last two sub-constructs, viz., individual and organizational impact, measure the benefits of success.

Respondents were required to evaluate questionnaire items using a five-point Likert scale ranging from 1 = ‘strongly disagree’ to 5 = ‘strongly agree’. This kind of questionnaire format is one of the most frequently used in social science research and has been shown to have stronger validity than other types of questionnaire (Schrischeim et al. 1991). Nevertheless, issues on the optimal number of response categories in the rating scales remain unresolved; some opt for the use of a seven-point Likert scale (Finstad 2010; Miller 1956) while others prefer a five-point scale (Cox III 1980; Elmore and Beggs 1975; Preston and Colman 2000).

For this study, the five-point Likert scale is preferred since there seems to be no statistically improvement of the reliability for among five-, seven- and nine-point rating scales using the same items (Elmore and Beggs 1975). Moreover, the seven-point Likert scale is more suitable for unsupervised or electronically distributed questionnaires (Finstad 2010). Preston and Colman (2000) suggest that different scales may be suitable for different purposes. Thus, in order to prevent respondents from being upset or discouraged, the five-point scale is perceived as a quick and easy method especially when respondents have to complete the questionnaire under time pressure. However, Preston and Colman (2000) emphasized that, if face validity is a major concern, then the 10-point scale is encouraged.

As for the determinants of HIS success, several theoretical constructs are identified as possible factors to system implementation success. Existing measures that had been used in past studies were adapted in the study in order to ensure the content validity of the scale used (De Vaus 2002; Zmud and Boynton 1991). The constructs’ measures were mostly taken from pertinent ERP studies. In Chapter 3 of the literature, the relevance of the ERP research in this study was justified. Table 4.10 depicts the measuring items for each success factor.

Table 4.10: Measuring Items for HIS Success Determinants

Constructs	Measurement Items	References
Top management and project championship	• The top management supports information technology implementation initiatives. • The top management demonstrates adequate commitment to the IT implementation. • The top management has sufficient knowledge about the projects. • The top management has realistic expectation of the projects. • The IT implementation received explicit identification from top management as a critical priority. • The top management provides necessary resources for IT implementation (e.g., manpower, training and incentives). • The IT project has a project champion. • The top management and champion communicate with project team and users. • The top management and champion provide related information with project team and users. • The project champion has strong leadership. • The project champion is empowered to make decisions (decision makers). • The project champion has business and technical competence.	Nah and Delgado (2006); Nah, Islam, and Tan (2007); Nah, Zuckweiler, and Lau (2003)
Business plan and vision	• The business or project plan and vision provide clear defined goals. • The business or project plan and vision contain realistic objectives. • IT return on investment (ROI) is justified in the business plan. • The business or project plan and vision provide benefits, resource allocation, costs, risks, and timeline. • The business or project plan and vision provide long-term vision that is integrated with company initiatives.	Nah and Delgado (2006); Nah, Islam, and Tan (2007); Nah, Zuckweiler, and Lau (2003)
Enterprise-wide communication	• Team(s) involved in the IT project clearly understood the goals/objectives/purposes of the implementation. • The project team was well-prepared to communicate effectively with the users. • There were enough communication channels to inform the users of the stage of the IT project and help users resolve problems. • There were enough evaluations to assess the workings of the IT systems. • Enough reviews were conducted to ensure continued IT end-user satisfaction.	Nah and Delgado (2006); Nah, Islam, and Tan (2007); Nah, Zuckweiler, and Lau (2003)

Constructs	Measurement Items	References
Project management	• Task assignments, project scope were well-defined during the IT implementation. • During the IT implementation, milestones were set with measurable results. • There was commitment to promote and manage the IT implementation project. • Regular communication of expectation and challenges, education, training, and support were provided during the IT implementation. • Customization of the IT systems was well managed by the business team. • Coordination of the project was well administered.	Nah and Delgado (2006); Nah, Islam, and Tan (2007); Nah, Zuckweiler, and Lau (2003)
Team composition	• The team selected for IT implementation had the best business knowledge. • The team selected for IT implementation had the best technical knowledge. • The team selected for IT implementation had the best business and technical knowledge. • A variety of cross-functional team was selected for the IT implementation. • The project had sufficient team members. • The project has dedicated and committed team members. • Those selected for the IT implementation were working on the project full-time as their only priority. • Those selected for the IT project were relocated together. • Sufficient incentives or compensation were given to those selected for the IT project.	Nah and Delgado (2006); Nah, Islam, and Tan (2007); Nah, Zuckweiler, and Lau (2003)
Change management and culture program	• Employees are supportive, cooperative and helpful. • Employees are encouraged or rewarded by their superiors to express and exchange their opinions and ideas regarding work. • There is willingness to collaborate across organizational units. • Adequate organizational resources are available to the employees (e.g., adequate user training and education). • Employees are encouraged to analyze mistakes that have been made and learn from them. • Opportunities are provided for individual development, other than formal training (e.g., work assignments and job rotation).	Nah and Delgado (2006); Nah, Islam, and Tan (2007); Nah, Zuckweiler, and Lau (2003)

Constructs	Measurement Items	References
System selection and technical implementation	• The IT system has all the functionalities required. • The IT system is linked with legacy (inherited) or existing systems. • The IT system worked well with technology already in place. • Vigorous and sophisticated testing has been conducted. • There is sufficient support for integration and troubleshooting. • The selection of the system requires minimum customization. • Long term infrastructure plans exists and are followed (e.g., data and network infrastructure). • There is IS/IT planning to keep up with changing technology.	Nah and Delgado (2006); Nah, Islam, and Tan (2007); Nah, Zuckweiler, and Lau (2003)

The literature shows that there are many possible factors for implementation success. However, due to the time, resource and budget limitations not all of the factors could be investigated. In fact, in this study some of the determinants were combined as a single factor in order to simplify the research model. Again, the five-point Likert scale measurement was used for this part of the questionnaire. For the complete questionnaire, refer to Appendix I.

During the pre-testing phase, which is explained in the following section, some interviewees suggested several measurement items should be articulated to ensure that the items are really measuring the constructs; their suggestions and recommendations have been incorporated into the questionnaire accordingly.

4.6.3.2 Pre-testing the Survey Instrument

Prior to questionnaire distribution, it is advisable to pre-test the questionnaire for its face validity and content validity. The former (face validity) is meant to ensure that participants are familiar with the terms used; the questions are well formed; unambiguous; and ratify that the questionnaire measure the concepts. Content validity, however, relates to the representativeness of the content or theoretical constructs in the questionnaire (Cavana, Delahaye, and Sekaran 2001). Hair et al. (2010) emphasize that a pre-test is indispensable to ascertain that if there are problems with the instrument that could be improved. Although the questionnaire in this study was formulated mostly from existing studies and it has been proven for its reliability and validity, a pre-test could assist determine whether it is still valid and reliable in the context of the study (De Vaus 2002).

Thus, a group of five experts of IT advisors from the Information Management Division, Ministry of Health, Malaysia were selected to pre-test and review the questionnaire. The respondents were IT advisors for the public hospital employees who were involved in the HIS selection and implementation process. Even though the number of respondents were small, these respondents were expert users and knowledgeable in their areas. Once respondents were briefed about the research project, time was given for them to complete the questionnaire. They were informed that the questionnaire was being developed and their expertise was required to improve them such as questions' wording, response categories and validity.

Based on their feedback, some questions had to be reworded to ensure clarity and similar meaning. It was discovered that respondents were uncertain of some of the words used in the questionnaire due to double or multiple meanings, as well as some new terms with which they were not familiar. They confirmed that the items did measure the theoretical construct. They even suggested incorporating a few questions (measurement items) that they felt relevant or necessary. Subsequently, the questionnaire was modified and ready for the pilot study.

4.6.3.3 Pilot Study

The purpose of a pilot study is to test the feasibility of the finalized questionnaire; it helps to reduce unanticipated problems by assessing the resource, time, human and data management problems. The results of the pilot study can assist in improving the questionnaire, ascertain the reliability and validity of the measurement items and guide the researcher as to whether or not the research is doable. Unlike the pre-test, a pilot study allows preliminary testing of the hypotheses which offers insights to the actual situation (Thabane et al. 2010).

The main issue with a pilot study is to gather a sufficient number of participants to carry it out. It is suggested that the finalized questionnaire should be piloted with a reasonable sample of respondents who come from the target population or resemble the target population (Cavana, Delahaye, and Sekaran 2001). Thus, the finalized questionnaire was sent through email with a cover letter informing recipients of the intention and the importance of the survey, assurance of confidentiality, definition of terms and instructions on how to complete the survey.

Some of the issues faced during the pilot study were to collect usable responses and increase the number of respondents. Due to their hectic workloads, most of the respondents were not able to complete the questionnaire. Additionally, to avoid contamination of data, the data from the pilot study was not included in the main results as it was difficult to get more respondents. If the same participants were to carry out the actual survey, the concern was they could be bias to the questionnaire.

In total, there were 30 usable responses received from the pilot study. After analyzing the correlation coefficients through IBM SPSS Statistics 19.0 software, items with a coefficient less than 0.5 were taken out from the questionnaire. Additionally, to test the reliability of the measuring items, Cronbach's Alpha coefficients were computed for all sets of items measuring the construct. Several items were removed from the questionnaire in order to improve the Cronbach's Alpha value which should be higher than 0.7 as suggested by Hair et al. (2010).

4.6.4 Quantitative Data Collection

Prior to the distribution of the actual questionnaire, there were two ethics approvals required. The first ethics endorsement was obtained from the university itself and the second approval was given by Malaysia's Ministry of Health Medical Review and Ethics Committee (MREC). When MREC had approved the study, an authorization letter was given to the researcher which allowed the survey to be conducted at the respective hospitals; with this letter, the public hospital employees were obliged to participate in the survey.

The finalized questionnaire, with modifications from both the pre-test and pilot study, was distributed to public hospital employees in November 2010 with the main respondents being HIS users, implementers and maintenance personnel. Prior to the distribution, the questionnaire was translated into Bahasa Malaysia which is the national language, and then back-translated to ensure that the meanings were the same as in the original questionnaire. Similar to the pilot study, the questionnaire had a cover letter explaining the researcher's intentions, definition of terms and instructions on how to complete the questionnaire. The main difference was the method of distribution whereby, in the actual survey, the self-administered approach was used.

Given that six hospitals took part in the survey, a contact person was appointed in each hospital to manage the distribution of questionnaires. The contact person as a staff member of the IT department, was responsible for distributing and collecting the questionnaire evenly to various departments in the hospital, ensuring that the respondents were HIS users, implementers or maintainers.

Considering the nature of their work, respondents were given three months in which to complete the questionnaire; considered a more than ample time. At the end of January 2011, 195 responses were collected; though not all of the responses were returned. Therefore, in an attempt to increase the responses, a new deadline was given. In March 2011, another 56 responses were collected. At the end of April 2011, a total of 325 responses had been collected. The questionnaire response rate is discussed in detail in Chapter 5 (Section 5.2).

4.6.5 Data Analysis Procedure

Both the first and second generation statistical techniques were used in the study. The first generation techniques such as descriptive statistics and correlation were used mainly during the data screening and cleansing process. Initially, multiple regression (also known as ordinary least square, linear regression) technique was considered for analyzing the data. However, after much investigation, the regression technique was found inappropriate. Only by investigating the interactions among the

CSFs and HIS success via structural equation modeling could the researcher expect to shed light on the complex relationships among constructs.

A few concerns with the first generation technique were limitations related to simple models and that assumptions of all variables were observable and measured without error. Haenlein and Kaplan (2004) argued that, in reality, human beings are living in a complex world and a simple model may not provide an adequate explanation. Also, although it is not feasible to build all aspects of reality into a model, a statistical technique such as regression may be too restrictive, particularly when one needs to explore the possibility of mediating or moderating variables.

The assumption that all variables are observable is also impractical in that latent variables such as intelligence, timeliness and life stress cannot be measured directly. Latent variables are unseen variables that are measured using observable variables or indicators (Hair et al. 2010), Hence, several indicators (also called items, observable or manifest variables) are needed to describe these latent variables. Lastly, the notion that variables can be measured without errors is totally unrealistic according to Bagozzi, Yi, and Phillips (1991) who argue that there are always errors in measurement; viz., random errors (missing values) and systematic errors (faulty instrument).

To overcome these limitations, the structural equation modeling (SEM), the second generation statistical technique, was used in the study. SEM offers several advantages as it permits simultaneous modeling of relationships between multiple independent and dependent constructs. The SEM technique also allows researchers to answer interrelated research questions in a single, systematic and comprehensive analysis (Gefen, Straub, and Boudreau 2000). According to Hox and Bechger (1998), the SEM method is able to assess the model fit and is a comprehensive statistical approach to test relationships between observed and latent variables (Hoyle 1995; MacCallum and Austin 2000). Gefen, Straub, and Boudreau (2000) emphasize that SEM not only evaluates the structural model but it is able to assess the measurement model within the same analysis. Most significantly, it treats measurement errors, latent variables and complex model limitations of the first generation techniques.

There are two approaches to SEM, namely, the covariance-based approach and the variance-based (also called component-based) approach. The covariance-based approach is the dominant approach for SEM and, normally, is implemented using LISREL, AMOS, EQS, and RAMONA. On the contrary, the component-based PLS approach differs in its analyses' objectives, statistical assumptions and the fit statistics (Gefen, Straub, and Boudreau 2000).

For this study, the SEM PLS-based approach was employed. Software packages utilized for the data analysis were PLS-Graph 3.0 and IBM SPSS Statistics 19.0. The main motive for using PLS analyses was due to the model's complexity with more than 100 indicators. Additionally, the objective of PLS analyses matches one of the objectives in this study; viz., to predict whether the candidate success factors contribute to a successful implementation. The details of the PLS analyses are described in Chapter 5 (Section 5.4).

4.7 Summary

In this chapter, the research paradigm and the epistemology of the study have been reviewed. Based on the research problem and review of related literature, the positivist paradigm was determined to be the most appropriate. The study stance was justified in Section 4.2.2 and Section 4.3.3. Next, the research process was described. The main objective was to identify the research key processes and it was assumed that provided the researcher understood the research process, it would be simpler to design the actual study.

Details of the research design also have been presented. Among the important tasks to be performed during this phase was constructing the questionnaire using the theoretical constructs identified from the literature. Additionally, the measurement scale for each of the constructs was described as being valid and reliable. The questionnaire was tested for its face validity and content validity, and a pilot study conducted to further improve the reliability and validity of the measurement items in the questionnaire.

Later, after the reliability and validity test was performed on the questionnaire, it was distributed to six public hospitals in Malaysia. A brief description of how the data was analyzed is presented next; the details of the analyses techniques chosen for the study are provided in Chapter 5.

Chapter 5

Data Analysis and Results

The beginning of knowledge is the discovery of something we do not understand.
Frank Herbert (1920 – 1986)

5.1 Introduction

In this chapter, the statistical techniques chosen to analyze the data are described and the results of the data analysis presented. The chapter comprises seven main sections. The first section provides an introduction to the chapter and analysis of the response rates analysis is described. This is followed by the demographic profile of the participating hospitals. The succeeding part introduces the Structural Equation Modeling (SEM) approach in combination with the Partial Least Squares (PLS) technique and the results of the data analysis are presented. The ensuing section supplies the results of testing the hypotheses, while the chapter is summarized in the last section.

5.2 Response Rates

A total of 500 questionnaires were distributed to public hospital employees with a return of 325 questionnaires, an initial return rate of 65 percent[10]. During the first round of data collection, only 249 questionnaires were returned. Therefore, a new cut-off date was given to the hospitals and the late respondents contributed another 76 questionnaires. Nevertheless, 112 subjects whose responses substantially missed key measures such as project management and system quality measures were eliminated from the sample. This resulted in a final sample size of 213. As this study used PLS as its main analysis technique, the sample size of 213 was considered

[10] The distribution of 500 questionnaires were determined based on Krejcie and Morgan (1970) study.

adequate as confirmed by Barclay, Higgins, and Thompson (1995) who assert that the rule of thumb in deciding the minimum sample size in PLS is either 10 times the number of indicators on the most complex formative construct, or the largest number of independent variables impacting a dependent variable, whichever is greater. Calculating from the research model, the minimum sample size required for the study was 70 samples[11].

Hence, the usable response rate for the survey was 42.6 percent (refer Table 5.1). This is considered high because most Malaysian research usually receives a 15 – 25 percent response rate (Othman, Abdul-Ghani, and Arshad 2001). Instead of using internet questionnaires or web survey, which is becoming a popular method, the current study utilized the self-administered approach. The Malaysian public hospital employees have limited access to the internet, so selecting the self-administered approach was the best option for the study as the self-administered approach is known for its high response rate. This probably explains the positive response rate received in the study (Dillman 1991; Stover and Stone 1974). Table 5.1 reflects the response rates for each hospital.

Table 5.1: Overview of Response Rates

Hospitals	**Total No. Distributed**	**Total Returned**		**Total Usable**	
Ampang	80	50	62.5 %	35	43.8 %
Selayang	80	48	60.0 %	26	32.5 %
Serdang	80	50	62.5 %	35	43.8 %
Sg. Buloh	80	51	63.8 %	35	43.8 %
Putrajaya	80	50	62.5 %	38	47.5 %
S. Bahiyah	100	76	76.0 %	44	44.0 %
	500	**325**	**65.0 %**	**213**	**42.6 %**

[11] A complete explanation on sample size was provided in Section 4.6.2 of Chapter 4.

5.2.1 Non-Response Bias

Non-response bias refers to the probability that if the non-respondents had responded; their responses would have substantially changed the results of the survey. This potential bias is presumed to impact the generalizability and the validity of the survey results. Nevertheless, the degree of non-response bias depends on: 1) the percentage of the non-respondents and 2) the extent to which non-respondents' answers differ; i.e., whether they are statistically significant or not (Barclay et al. 2002). The non-response error must be addressed to ensure that the data is valid and can be used for further analysis.

Among the common techniques to assess non-response bias are: comparing with known values for the population (e.g., age, income), using subjective estimates (e.g., level of education) and applying extrapolation methods (e.g., successive waves, time trends) (Armstrong and Overton 1977). The current study used a combination of these techniques. Three demographic variables (i.e., age, job tenure and level of education) and three indicators from the latent variable constructs (i.e., top management, change management/culture program and system quality) were chosen for the non-response bias test. The time trends extrapolation method was applied where the late respondents were treated as non-respondents. Hence, the respondents were divided into two groups and identified as early and late respondents.

The non-parametric Mann-Whitney test was used to test for differences between the two groups. The non-parametric test was preferred over a *t*-test because the samples did not meet the normality assumption. The test showed no statistically significant differences between the two groups (refer Table 5.2). Hence, non-response bias was not considered a threat in the study.

Table 5.2: Mann-Whitney Test for Non-response Bias

Item	*p* value	Significant
Age	0.940	No
Job Tenure	0.182	No
Education Level	0.611	No
Top management and project championship: The top management provides necessary resources for IT implementation	0.305	No
Change management and culture program: Opportunities are provided for individual development, other than formal training.	0.088	No
System quality: The response and turnaround time of the HIS system is acceptable.	0.174	No

5.2.2 Missing Values

In Section 5.2 it was noted that 112 responses had to be removed because participants failed to respond to crucial questions on HIS implementation. Although the remaining respondents did not answer some demographic information, it was not essential to perform missing values analysis on them. The main intention of the thesis was to investigate factors leading to a successful implementation; therefore, missing demographic profiles were considered not to detract from the content analysis.

Although six public hospitals participated in the survey, the demographic profile of respondents was not divided between the hospitals; the prime reason being the usable samples for each hospital did not meet the minimum sample size for PLS analysis (Barclay, Higgins, and Thompson 1995). Moreover, these hospitals are public hospitals where they are governed by the same body (Malaysia's Ministry of Health) and have the same policies and procedures, thereby ensuring data homogeneity and justifying the amalgamation of data for the purpose of analysis. Moreover, for PLS analyses, the parametric assumptions are relaxed.

5.2.3 Common Method Bias

Common method bias arises when the measurement method the researcher employs influences the data being gathered. For many researchers, this is a potential problem because it leads to false conclusions; in other words, this causes measurement error (Podsakoff et al. 2003). To mitigate the impact of common method bias in this study, suggestions by Podsakoff et al. (2003) were taken into account.

There are two techniques for controlling common method bias; viz., procedural and statistical remedies. To adopt the most practical approach, for this study procedural remedies were selected, thereby using the *protecting respondents' anonymity and reducing evaluation apprehension* option. This technique reduces consistency, social desirability, leniency and acquiescence biases (Podsakoff et al. 2003). Upon sending the questionnaire to the respondents, a cover letter was attached to explain that respondents' responses are anonymous. Another procedural option selected was *improving scale items*. This was achieved by defining vague terms and concepts, ensuring that questions are simple and non-double-barreled, and avoiding bipolar numerical scale values by using verbal labels as recommended by Tourangeau, Rips, and Rasinski (2000).

Guaranteeing anonymity does not eliminate common method bias. As a result, Podsakoff et al.'s (2003) Harman single-factor test or statistical remedy also was performed. To complete Harman's test, all indicators were entered into exploratory factor analysis using unrotated principal component factor analysis. If a substantial amount of common method variance is present, either a single factor will emerge from the factor analysis, or one general factor will account for the majority of the covariance among the indicators (Podsakoff et al. 2003). In this study, Harman's test revealed the presence of 12 distinct factors, rather than a single factor, indicating that common method bias is not a likely threat. Regrettably, the techniques suggested by Podsakoff et al. (2003) do have some limitations. Nonetheless, Doty and Glick (1998) assert that most detected bias is insufficient to invalidate the research findings.

5.3 Demographic Profile of Participants

In this section the demographic profile of the research participants is presented. Table 5.3 exhibits the respondents’ profile. The respondents are classified according to eight distinct categories; viz., gender, age, project involvement, technology experience, tenure, position, project role and education level.

The survey results demonstrate that female respondents (63.4%) are almost two thirds more than the male respondents (36.6%), and that 70% of the respondents are below 35 years of age. This indicates that respondents are mostly from Generation X and Y where technology should not be an unknown topic for them.

In terms of experience, 20.2% of respondents have been involved in the HIS implementation project more than five years. Additionally, those with IT or technology experience of more than five years comprised 29.6% of the total. The results also indicate that 54.9% of the respondents are end-users; the remainder of the respondents (45.1%) can be classified as experts in the system. This composition suggests that most respondents are ‘early career’ persons in HIS implementation.

Regarding education level, 49.3% have at least a bachelor’s degree. 40.4% of the respondents hold a managerial position and most respondents (73.3%) have been in the organization for at least five years. This suggests that, generally, respondents are familiar with common management concepts such as planning, organizing, controlling and coordinating.

Table 5.3: Profile of Respondents

Characteristics	Item	Frequency	Percentage (%)
Gender	Male	78	36.6
	Female	135	63.4
Age	24 and under	14	6.6
	25 – 34	135	63.4
	35 – 44	37	17.4
	45 – 54	23	10.8
	55 and above	4	1.9
Project involvement *	Less than 1 year	34	16.0
	1 – 5 years	132	62.0
	More than 5 years	43	20.2
Tenure	Less than 1 year	30	14.1
	1 – 5 years	126	59.2
	6 – 10 years	36	16.9
	More than 10 years	21	9.9
Technology (IT) experience	Less than 1 year	18	8.5
	1 – 5 years	132	62.0
	6 - 10 years	43	20.2
	More than 10 years	20	9.4
Project role	Project Champion	8	3.7
	End-user	117	54.9
	Vendor	37	17.4
	Key-user	40	18.8
	Technical Advisor	11	5.2
Job position *	Managerial	86	40.4
	Non-managerial	53	24.9
	Others	71	33.3
Education level	Diploma	92	43.2
	Bachelors	71	33.3
	Masters	34	16.0
	Other	16	7.5

Note: * Missing responses identified for project involvement and job position. N = 213.

The next section explains the main PLS-based SEM statistical technique employed in the study.

5.4 Data Analysis Technique

From the research model presented in Chapter 3, SEM appears to be the most suitable approach for data analysis. SEM, a second generation data analysis technique, is a complex statistical approach; however, it has many advantages compared to the first generation techniques. The first generation techniques (e.g., analysis of variance, discriminant analysis and multiple regression analysis) have three main limitations. The first limitation is that studies that employ the first generation statistical techniques usually have simple and straightforward research models. The second constraint is that these techniques assume that all variables can be measured or are observable and the third limitation is that first generation techniques theorize that all variables are measured without errors (Haenlein and Kaplan 2004). Furthermore, first generation techniques can only analyze one relationship at a time between the independent and dependent constructs; which increases the possibility of measurement error when all relationships have to be considered.

SEM overcomes first generation limitations by allowing the researcher to perform simultaneous testing of all the relationships between constructs in a systematic and comprehensive analysis (Gefen, Straub, and Boudreau 2000). Also, it allows estimation of relationships among multiple independent and dependent constructs, latent variables construct, measurement errors and confirmatory factor analysis (Chin and Newsted 1999).

SEM has two distinct approaches: covariance-based and component-based SEM. The former method uses software packages such as LISREL, EQS and AMOS. Conversely, component-based, also known as partial least squares-based (PLS-based), uses tools such as PLS-Graph, PLS-PC and SmartPLS. These approaches differ in their analysis objectives, statistical assumptions and many more as summarized in Table 5.4. Typically, the covariance-based SEM is used to obtain models' goodness of fit whereas PLS-based is used to maximize prediction rather than fit (Chin and Newsted 1999). Also, PLS-based has fewer restrictions on measurement scale, sample size, data distribution and normality (Chin 1998b).

The PLS-based approach is applicable for this study for several reasons. First, the prediction capability of PLS-based is most useful in meeting the study objective of identifying the determinants of HIS success. Second, the research model has 159 indicators and both formative and reflective constructs[12]. Based on the comparison, only the PLS-based approach could satisfy these requirements because the covariance-based SEM only caters for indicators less than 100 and models reflective constructs. Third, the available data does not fulfill the parametric multivariate normality assumption of covariance-based SEM. Therefore, the non-parametric assumption of PLS-based is favored.

Table 5.4: Comparison between Covariance-based and Component-based SEM

Criteria	Covariance-based	Component-based
Objective	Parameter oriented	Prediction oriented
Approach	Covariance-based	Variance-based
Implications	Optimal for parameter accuracy	Optimal for prediction accuracy
Statistical assumptions	Multivariate normality (Parametric)	Predictor specification (Non-parametric)
Required Theory Base	Requires sound theory base	Does not require sound theory base
Required minimal sample size	Minimal recommendations range from 200 – 800 cases	At least 10 times the number of items in the most complex formative construct
Model complexity	Small to moderate complexity (e.g., less than 100 indicators)	Large complexity (e.g., 100 constructs and 1000 indicators)
Model evaluation	Goodness of fit, overall model fit, χ^2, AGFI	High R-square, significant *t*-values, jack-knifing or bootstrapping for significance test,
Epistemic relationship between latent variable and its measures	Can be modeled in reflective mode only	Can be modeled in both formative and reflective mode
Best suited for:	Confirmatory research and theory testing	Exploratory research and theory building

Source: Adapted from Chin and Newsted (1999) and Gefen, Straub, and Boudreau (2000).
Note: The characteristics of formative and reflective construct are provided in Section 5.4.1.

[12] Additional information on formative and reflective constructs is given in Section 5.4.1.1.

The first step in PLS is to model explicitly the measurement and structural component. The next section explains how these models are assessed using the PLS-based SEM technique.

5.4.1 PLS Assessment

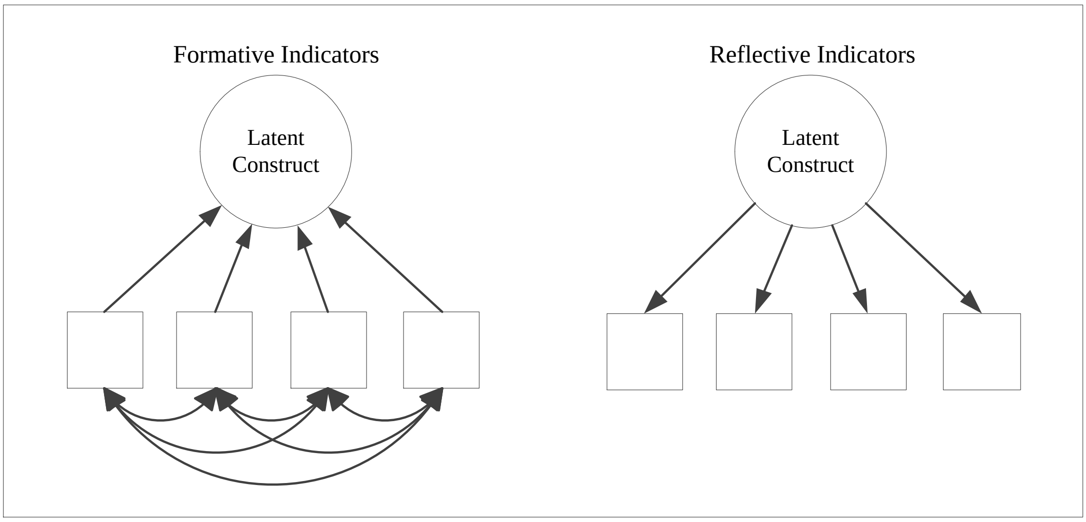
There are two main stages for PLS assessment. In the first stage, the assessment of the measurement model is performed. Then, in the second stage, the assessment of the structural model is conducted (Barclay, Higgins, and Thompson 1995).

5.4.1.1 Measurement Model Assessment

A measurement model describes how the latent constructs and their measurement items (indicators) are related (Chin and Newsted 1999). Latent constructs, also called unobservable variables, are measured by indicators or observable variables. There are two types of indicators that can be used to measure latent constructs; formative and reflective indicators. The former implies that the indicators form, cause or change the latent construct (Chin 1998a; Fornell and Larcker 1981). Typically, formative indicators are drawn with an arrow from each indicator leading to the latent construct (see Figure 5.1). Formative indicators do not have to be interchangeable or have the same underlying concept (Chin 1998a; Jarvis, MacKenzie, and Podsakoff 2003).

Alternatively, the latter are a reflection of the latent constructs, interchangeable and correlated by representing the same underlying concept (Gefen, Straub, and Boudreau 2000). Reflective indicators are drawn with an arrow leading away from the latent construct (see Figure 5.1). The default relationship between latent constructs and indicators is reflective (Petter, Straub, and Rai 2007). Reflective indicators should be preferred when the purpose is to test a theory rather than build a theory and when the construct is well-defined based on theory (Chin 1998b; Gefen, Straub, and Boudreau 2000). Both types of indicators, formative and reflective, are supported by PLS (refer Table 5.4). In this study, most of the constructs are reflective with the exception of HIS success.

Figure 5.1: Formative and Reflective Indicators



Source: Adapted from Chin (2000).

The measurement model needs to be assessed to ensure the accuracy of the structural model; therefore, in the first stage of PLS assessment, the reliability and validity of the measurement model is measured by examining the construct validity. Construct validity implies how the measurement instrument fits the theoretical concept (De Vaus 2002; Sekaran 2003). Construct validity of an instrument is assessed through two main components: 1) convergent validity and 2) discriminant validity (Sekaran 2003).

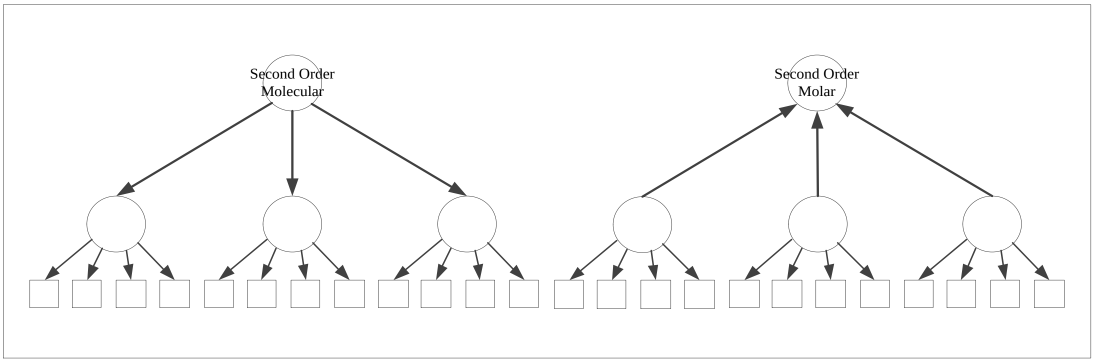
Convergent validity is established when each of the measurement items loads with a significant *t*-value of at least 1.96 on its corresponding latent construct (Gefen and Straub 2005). Therefore, this involves individual item reliability and internal consistency analysis for PLS-based SEM. Item reliability is assessed by inspecting the items' loadings to its corresponding latent construct. If the loading is less than 0.7 then the item is removed. On the other hand, internal consistency is a measure of reliability. It is measured by composite reliability and average variance extracted (AVE). Composite reliability is similar to Cronbach's Alpha but better, as the former does not assume that all indicators are equally weighted and is not affected by the number of items in the scale (Barclay, Higgins, and Thompson 1995; Fornell and Larcker 1981). The acceptable value for composite reliability is greater than 0.7 and for AVE is 0.5 (Fornell and Larcker 1981).

The second assessment for construct validity is the assessment of discriminant validity. Discriminant validity is the degree to which items are different or uncorrelated with other latent constructs or measure distinct concepts (Barclay, Higgins, and Thompson 1995; Gefen and Straub 2005). For sufficient discriminant validity, each measurement item should correlates strongly on its respective construct to which it is theoretically associated. It can be assessed by: 1) inspecting the square root of every AVE which must be higher than any correlations among any pair of the latent constructs and 2) the measurement items should load highly only on their respective latent construct (Gefen and Straub 2005). The first type of assessment is meant to assess at the construct level and the second is for the indicator level (Barclay, Higgins, and Thompson 1995).

5.4.1.2 Structural Model Assessment

Only once the reliability and validity of the constructs have been established can the structural model be assessed. A structural model describes the paths or relationships between the endogenous (dependent variable) and exogenous (independent variable) constructs. Also, the structural model permits second order factor modeling. This model is appropriate when conceptual models are at a higher level of abstraction. The second order factors are not directly connected to any measurement items; instead they are connected to the first order factors and are measured by the measurement items of the first order factors (Chin 1998a). As demonstrated in Figure 5.2, a second order factor can be modeled by using the molecular or molar approaches.

Figure 5.2: Second Order Constructs – Molecular and Molar Approaches



Source: Adapted from Chin (2000).

There are two forms of second order construct: 1) molecular (reflective) and 2) molar (formative) (see Figure 5.2). The molecular is appropriate when the first order factor is considered a reflective indicator for the second order. On the other hand, the molar approach is used when the first order factor is considered as the cause for the second order (Chin and Gopal 1995). It is important that the correct approach is selected carefully as a misspecification of construct could increase type I and type II errors (Gable, Sedera, and Taizan 2008; Petter, Straub, and Rai 2007).

In the theoretical framework described in Figure 3.5, the dependent variable is designed as a second order reflective construct. The framework extends the work of Sedera and Gable (2004) with an additional first order factor, which is service quality. The reflective measures are preferred because the risk with formative measures is that the elimination of one measure could affect the representativeness of the construct (Petter, Straub, and Rai 2007). Also, it is difficult to verify that all the relevant measures of the formative construct are represented (Bagozzi and Phillips 1982; Fornell and Bookstein 1982; Gable, Sedera, and Taizan 2008). Fornell and Bookstein (1982, 441) assert that formative measures are not meant to measure observable variables but "are used to minimize residuals in the structural relationship".

Another issue with the formative construct is that researchers do not have sufficient knowledge to correctly identify formative constructs (Jarvis, MacKenzie, and Podsakoff 2003; Petter, Straub, and Rai 2007). As a result, there is no concrete guidance on how to specify formative constructs. Howell, Breivik, and Wilcox (2007b) strongly suggest using reflective measurement by arguing that if formative measures need not have the same underlying concept, then where is the rationality to form them into a single composite construct. Other studies by Wilcox, Howell, and Breivik (2008) and Howell, Breivik, and Wilcox (2007a) reveal that formative measurement is acceptable if the main purpose is to predict and not test theory. Using the above studies as guidelines and Jarvis, MacKenzie and Podsakoff's (2003) recommendations for determining formative or reflective constructs, resulted in the choice of the second order reflective construct in the structural model being considered suitable for this study.

Typically, the assessment of the structural model involves testing the explanatory power and significance of the path coefficients among the latent constructs (Chin and Newsted 1999). In order to evaluate the predictive power of the exogenous variables in the structural model, the R^2 value for each endogenous variable must be computed. R^2 is interpreted similarly to the results of multiple regression analysis whereby they specify the amount of variance of endogenous variable that is explained by the model (Barclay, Higgins, and Thompson 1995).

On the contrary, path coefficients can be attained by performing bootstrapping on the structural model. Bootstrapping is similar to the traditional *t*-test and the results are used to interpret the significance of the paths. The hypothesis for each path can then be tested by assessing the path coefficients. The path coefficients can be interpreted in the same manner as the path coefficients in regression. They indicate the strength of the relationships between latent constructs (Chin 1998b).

Additionally, the structural model allows the assessment of mediating (indirect) effects, direct effects and total effects of the exogenous variables on the endogenous variables. A direct effect represents the relationship between an exogenous and endogenous variable. Conversely, an indirect effect, is the effect of an exogenous on the endogenous variable through one or more intervening variables (Hoyle 1995). The total effect is the sum of both direct and indirect effects of an exogenous on the endogenous variable.

Though countless researchers have used the term mediating effect and indirect effect interchangeably, Preacher and Hayes (2004) differentiate them by noting that a mediated effect must have the assumption that a total effect is present with only one intervening variable; an indirect effect does not have that assumption. In this study, the indirect effect examination only considered one intervening construct. Among the many methods of assessing indirect effects, the Baron and Kenny (1986) approach was adopted in the current study. Baron and Kenny (1986) advocate the use of the Sobel (1982) test that is a direct test of an indirect effect. MacKinnon et al. (2002) affirm that from their comparison of 14 methods of assessing mediation effects, Sobel's test is superior in terms of power and intuitive appeal.

Finally, the structural model is assessed for its moderating effects. A moderating effect happens when a variable changes the effect between two related latent constructs (Hair et al. 2010). In this study, the multi-group approach was chosen to test the hypothesized moderating effects, as the hypothesized moderators (i.e., age, gender, job position, project role, education level, and technology experience), are categorical variables. Table 5.5 summarizes the analyses for this study and the results of the data analysis are presented in the next section.

Table 5.5: Summary of the PLS Analysis

PLS Assessment	Analysis

Stage 1
 	
Assessment of the Measurement Model
	Construct Validity
	
	• Convergent Validity
	   o Individual item reliability analysis
	   o Internal consistency analysis
	• Discriminant Validity
	   o Cross-loadings analysis
	   o Average variance extracted analysis

Stage 2 Assessment of the Structural Model	• Explanatory power (R^2) analysis • Path coefficients and statistical significance *t*-values analysis • Direct, indirect and total effect analysis • Moderating effect analysis

5.5 Data Analysis Results

In this section the results of the data analysis are reported. As explained in Section 5.4.1, the evaluation of the research model was performed in two stages. Therefore, the measurement model assessment is presented first, followed by the evaluation of the structural model. Besides the two-stage PLS analyses, the direct, indirect, total and moderating effects on the structural model were examined in order to provide a more complete understanding of the structural model.

5.5.1 Assessment of the Measurement Model

In evaluating the measurement model, two main analyses were performed: 1) convergent validity and 2) discriminant validity. Figure 5.3 illustrates the measurement model. The HIS success construct is highlighted to indicate that it is a second order molecular construct. Given the second order factor has five first order factors, they are collapsed in the diagram to provide a simplistic picture. The subsequent section reports the evaluation of the measurement model.

5.5.1.1 Convergent Validity

In PLS, the convergent validity was assessed by inspecting the individual item reliability and internal consistency. The former was assessed measuring the loadings of items on its respective latent construct. To obtain the items loadings, composite reliability, and AVE, PLS-Graph 3.0 bootstrapping method was executed. The results of the item reliability are presented in Table 5.6.

Figure 5.3: The Measurement Model

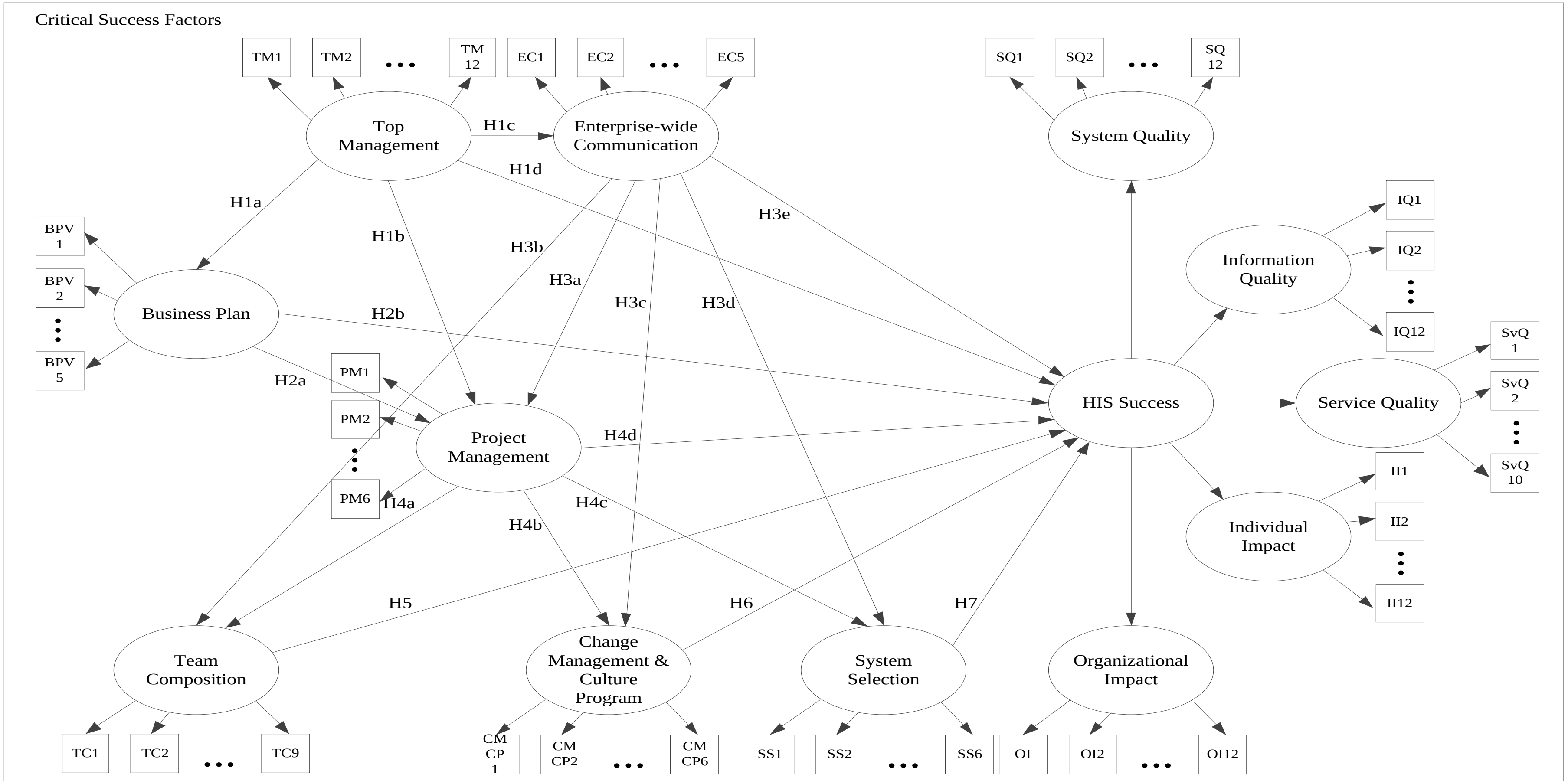


Table 5.6: Reliability and Validity Assessment of the Initial Model

Construct	Item	PLS Loading	Composite Reliability	AVE
Top management and project championship	TM1	0.6021	0.946	0.595
	TM2	0.7572		
	TM3	0.7526		
	TM4	0.8211		
	TM5	0.7404		
	TM6	0.8092		
	TM7	0.7459		
	TM8	0.8446		
	TM9	0.8518		
	TM10	0.8490		
	TM11	0.6949		
	TM12	0.7495		
Business plan and vision	BP1	0.8209	0.938	0.750
	BP2	0.8845		
	BP3	0.8400		
	BP4	0.8842		
	BP5	0.8990		
Enterprise-wide communication	EC1	0.8624	0.940	0.758
	EC2	0.8781		
	EC3	0.8639		
	EC4	0.9063		
	EC5	0.8424		
Project management	PM1	0.8284	0.940	0.722
	PM2	0.7982		
	PM3	0.8660		
	PM4	0.8359		
	PM5	0.8653		
	PM6	0.8999		
Team composition	TC1	0.7790	0.938	0.630
	TC2	0.8450		
	TC3	0.8394		
	TC4	0.7753		
	TC5	0.7689		
	TC6	0.8595		
	TC7	0.8417		
	TC8	0.7689		
	TC9	0.6415		
Change management and culture program	CM1	0.7932	0.930	0.689
	CM2	0.7873		
	CM3	0.8817		
	CM4	0.8477		
	CM5	0.8304		
	CM6	0.8364		
System selection and technical implementation	SS1	0.8098	0.945	0.683
	SS2	0.8170		
	SS3	0.8374		
	SS4	0.8495		
	SS5	0.8614		
	SS6	0.7398		
	SS7	0.8713		
	SS8	0.8186		

Construct	Item	PLS Loading	Composite Reliability	AVE
System quality	SQ1	0.8502	0.964	0.727
	SQ2	0.8732		
	SQ3	0.8819		
	SQ4	0.8820		
	SQ5	0.8365		
	SQ6	0.8383		
	SQ7	0.8387		
	SQ8	0.8186		
	SQ9	0.8925		
	SQ10	0.8103		
Information quality	IQ1	0.8572	0.974	0.774
	IQ2	0.8628		
	IQ3	0.8999		
	IQ4	0.8861		
	IQ5	0.8671		
	IQ6	0.8815		
	IQ7	0.8791		
	IQ8	0.8899		
	IQ9	0.8719		
	IQ10	0.8850		
	IQ11	0.8985		
Service quality	SvQ1	0.8705	0.966	0.740
	SvQ2	0.8790		
	SvQ3	0.8754		
	SvQ4	0.8605		
	SvQ5	0.8649		
	SvQ6	0.8465		
	SvQ7	0.8416		
	SvQ8	0.8730		
	SvQ9	0.8709		
	SvQ10	0.8205		
Individual impact	II1	0.9097	0.977	0.825
	II2	0.9267		
	II3	0.9286		
	II4	0.9385		
	II5	0.9381		
	II6	0.9333		
	II7	0.8902		
	II8	0.8585		
	II9	0.8452		
Organizational impact	OI1	0.6882	0.958	0.694
	OI2	0.8929		
	OI3	0.8964		
	OI4	0.8622		
	OI5	0.7819		
	OI6	0.7941		
	OI7	0.8166		
	OI8	0.8797		
	OI9	0.8472		
	OI10	0.8482		

The Nunnally (1978) reliability guideline of 0.7 was adopted in this thesis. Hulland (1999) emphasizes that loadings of 0.7 or more imply that the shared variance between the construct and its measure is more than the error variance which indicates that more than 50% of the variance is accounted for by the respective construct. Therefore, a few measurement items (i.e., TM1, TM11, TC9 and OI1) were dropped after the initial run. The next assessment of convergent validity was to assess the internal consistency. The results of the internal consistency are reported in Table 5.7.

Table 5.7: Internal Consistency of the Initial Model

Construct	Composite Reliability	AVE	Cronbach Alpha
Top management and project championship	0.946	0.595	0.937
Business plan and vision	0.938	0.750	0.917
Enterprise-wide communication	0.940	0.758	0.919
Project management	0.940	0.722	0.922
Team composition	0.938	0.630	0.925
Change management and culture program	0.930	0.689	0.909
System selection and technical implementation	0.945	0.683	0.933
System quality	0.964	0.727	0.965
Information quality	0.974	0.774	0.974
Service quality	0.966	0.740	0.961
Individual impact	0.977	0.825	0.975
Organizational impact	0.958	0.694	0.950

The results demonstrate that there is convergent validity and good internal consistency in the measurement model. The composite reliability exceeds the acceptable cut-off point of 0.7 and the AVE is greater than 0.5. For comparison purposes, a Cronbach's Alpha is also provided. The values are above the minimum requirement of 0.7 for all constructs which suggest a good internal consistency (Fornell and Larcker 1981; Nunnally 1978). Hence, the reliability of all latent constructs was verified. Next, the discriminant validity was assessed.

5.5.1.2 Discriminant Validity

After assessing the convergent validity of the measurement model, the discriminant validity of the measurement was evaluated. Two tests were required to determine discriminant validity: 1) analysis of cross-loadings and 2) analysis of average variance extracted (AVE).

Sufficient discriminant validity is when a construct shows more variance with its measures than it shares with other constructs in a given model (Hulland 1999). Upon examining the analysis of the cross-loadings, several items appeared to load highly on other constructs. Therefore, to ensure that each measurement item loaded highly on its respective construct, only items with loadings greater than 0.8 were retained. The final results of the measurement items and internal consistency are reported in Table 5.8.

Table 5.8: Reliability and Validity Assessment of the Final Model

Construct	Item	PLS Loading	Composite Reliability	AVE
Top management and project championship	TM4	0.8164	0.933	0.738
	TM6	0.8394		
	TM8	0.8954		
	TM9	0.8957		
	TM10	0.8544		
Business plan and vision	BP1	0.8227	0.938	0.750
	BP2	0.8856		
	BP3	0.8393		
	BP4	0.8831		
	BP5	0.8976		
Enterprise-wide communication	EC1	0.8620	0.940	0.758
	EC2	0.8787		
	EC3	0.8646		
	EC4	0.9060		
	EC5	0.8418		
Project management	PM3	0.8760	0.941	0.801
	PM4	0.8769		
	PM5	0.9058		
	PM6	0.9198		
Team composition	TC2	0.8950	0.928	0.762
	TC3	0.8876		
	TC6	0.8723		
	TC7	0.8366		

Construct	Item	PLS Loading	Composite Reliability	AVE
Change management and culture program	CM3 CM4 CM5 CM6	0.8573 0.8866 0.8676 0.8647	0.925	0.755
System selection and technical implementation	SS3 SS4 SS5 SS7 SS8	0.8422 0.8699 0.8851 0.8817 0.8514	0.938	0.750
System quality	SQ1 SQ2 SQ3 SQ4 SQ5 SQ6 SQ7 SQ9	0.8725 0.8867 0.8979 0.8908 0.8410 0.8360 0.8218 0.8977	0.961	0.754
Information quality	IQ1 IQ2 IQ3 IQ4 IQ5 IQ6 IQ7 IQ8 IQ9 IQ10 IQ11	0.8573 0.8628 0.8999 0.8861 0.8673 0.8816 0.8788 0.8897 0.8718 0.8851 0.8985	0.974	0.774
Service quality	SvQ1 SvQ2 SvQ3 SvQ4 SvQ5 SvQ6 SvQ7 SvQ8 SvQ9 SvQ10	0.8705 0.8788 0.8756 0.8605 0.8650 0.8462 0.8415 0.8730 0.8709 0.8207	0.966	0.740
Individual impact	II1 II2 II3 II4 II5 II6 II7 II8 II9	0.9096 0.9267 0.9285 0.9384 0.9380 0.9333 0.8902 0.8587 0.8453	0.977	0.825
Organizational impact	OI2 OI3 OI4 OI7 OI8 OI9 OI10	0.9023 0.8898 0.8697 0.8235 0.8874 0.8712 0.8815	0.958	0.766

By removing items with loadings below 0.8, the AVE also improved for several constructs (i.e., top management, team composition, project management and organizational impact) as can be seen in Table 5.9.

Table 5.9: Internal Consistency of the Final Model

Construct	Composite Reliability	Initial Model AVE	Final Model AVE
Top management and project championship	0.933	0.595	0.738
Business plan and vision	0.938	0.750	0.750
Enterprise-wide communication	0.940	0.758	0.758
Project management	0.941	0.722	0.801
Team composition	0.928	0.630	0.762
Change management and culture program	0.925	0.689	0.755
System selection and technical implementation	0.938	0.683	0.750
System quality	0.961	0.727	0.754
Information quality	0.974	0.774	0.774
Service quality	0.966	0.740	0.740
Individual impact	0.977	0.825	0.825
Organizational impact	0.958	0.694	0.766

Analysis of cross-loadings involves the examination of loadings of the items with respect to the correlations of all constructs. According to Barclay, Higgins, and Thompson (1995) and Chin (1998b), a block of items should load more highly on its respective construct than it does on other constructs. Given that PLS-Graph 3.0 could not produce the output automatically, several steps were taken to produce the results. First, latent scores produced by PLS-Graph were copied into IBM SPSS 19. Second, bivariate correlation analysis was performed to produce a correlation table between all constructs and indicators. The final results of the cross-loadings are presented in Table 5.10.

The cross-loading results in Table 5.10 revealed that all items load higher on their respective constructs in comparison to their cross-loadings on the other constructs. For example, all five items (i.e., TM4, TM6, TM8, TM9 and TM10) for top management and project championship (TM) construct, loaded higher on TM as compared to other constructs (i.e., BP, EC, PM, TC, CM, SS, SQ, IQ, SvQ, II and

OI). This confirms that the measurement model has strong discriminant validity at the item level and meets the first discriminant validity norm (refer Table 5.5).

The second assessment in discriminant analysis was to examine the AVE shared between a construct and its measures as proposed by Fornell and Larcker (1981). PLS-Graph 3.0 was used to produce the AVE and correlations table. Nevertheless, the square root for each AVE had to be calculated manually and the values needed to be greater than any correlations of constructs in the table. For adequate discriminant validity, the diagonal elements should be significantly greater than the off-diagonal elements in the corresponding columns and rows (Barclay, Higgins, and Thompson 1995; Hulland 1999).

Table 5.11 contains the results with the AVE square root placed along the diagonal. The results demonstrate that the square root of AVE on the diagonal is greater than the off-diagonal elements across the row and down the column. This finding indicates that the results are satisfactory and confirms the establishment of the discriminant validity at the construct level. From the results, the requirements for discriminant validity were met. By meeting both convergent and discriminant validity requirements, it was confirmed that there is sufficient evidence for construct validity and reliability in the study. An evaluation of the structural model from the study is presented next.

Table 5.10: Cross-Loadings of Items to their Respective Constructs

Items	TM	BP	EC	PM	TC	CM	SS	SQ	IQ	SvQ	II	OI
TM4	.815	.562	.569	.589	.597	.527	.595	.469	.446	.402	.483	.580
TM6	.839	.538	.594	.598	.620	.557	.609	.489	.478	.402	.460	.558
TM8	.891	.594	.582	.623	.646	.481	.546	.407	.390	.379	.397	.523
TM9	.894	.571	.564	.625	.654	.523	.537	.425	.434	.409	.445	.571
TM10	.852	.636	.608	.702	.765	.546	.633	.500	.471	.422	.447	.578
BP1	.636	.823	.689	.691	.734	.585	.644	.515	.507	.478	.498	.598
BP2	.662	.886	.699	.766	.692	.592	.683	.554	.498	.460	.506	.631
BP3	.521	.839	.612	.564	.595	.561	.611	.525	.475	.431	.427	.561
BP4	.554	.883	.689	.664	.657	.596	.675	.539	.553	.497	.532	.654
BP5	.544	.898	.681	.660	.629	.568	.698	.593	.582	.519	.540	.676
EC1	.631	.750	.862	.748	.703	.643	.720	.563	.567	.585	.583	.659
EC2	.597	.677	.879	.710	.665	.721	.747	.574	.579	.619	.569	.689
EC3	.567	.650	.865	.723	.664	.742	.704	.559	.590	.654	.512	.591
EC4	.610	.699	.906	.735	.697	.729	.773	.663	.644	.587	.544	.655
EC5	.555	.620	.842	.651	.599	.664	.754	.631	.622	.548	.486	.596
PM3	.656	.707	.701	.876	.669	.629	.695	.550	.520	.503	.528	.644
PM4	.664	.636	.687	.877	.690	.692	.667	.515	.492	.512	.480	.578
PM5	.654	.709	.756	.906	.725	.664	.762	.647	.621	.588	.539	.667
PM6	.651	.726	.784	.920	.779	.715	.833	.645	.655	.596	.536	.684
TC2	.709	.663	.655	.718	.895	.597	.637	.552	.527	.473	.502	.630
TC3	.716	.670	.641	.708	.888	.585	.646	.569	.531	.494	.518	.610
TC6	.672	.700	.695	.697	.872	.688	.700	.592	.574	.537	.525	.689
TC7	.580	.642	.680	.676	.837	.627	.633	.512	.540	.508	.479	.568
CM3	.586	.617	.688	.678	.661	.857	.708	.622	.597	.578	.551	.622
CM4	.529	.542	.691	.698	.621	.887	.636	.581	.548	.553	.496	.569
CM5	.467	.566	.691	.599	.575	.868	.605	.505	.503	.515	.433	.527
CM6	.547	.604	.723	.645	.625	.865	.665	.541	.557	.587	.515	.602

Items	TM	BP	EC	PM	TC	CM	SS	SQ	IQ	SvQ	II	OI
SS3	.562	.604	.740	.730	.615	.627	.842	.655	.626	.544	.537	.620
SS4	.539	.619	.689	.665	.624	.637	.870	.660	.607	.483	.494	.580
SS5	.606	.668	.768	.774	.666	.710	.885	.662	.652	.633	.531	.658
SS7	.658	.746	.769	.757	.702	.627	.882	.591	.621	.512	.527	.686
SS8	.582	.677	.707	.657	.637	.659	.851	.658	.601	.514	.532	.643
SQ1	.485	.594	.573	.555	.594	.547	.640	.872	.681	.596	.639	.625
SQ2	.470	.547	.558	.548	.533	.537	.668	.887	.732	.561	.598	.611
SQ3	.460	.588	.587	.598	.586	.588	.661	.898	.737	.629	.668	.643
SQ4	.414	.525	.570	.574	.543	.567	.667	.891	.752	.598	.626	.647
SQ5	.497	.534	.625	.623	.517	.555	.667	.841	.737	.652	.622	.623
SQ6	.443	.513	.630	.575	.543	.590	.595	.836	.752	.694	.620	.620
SQ7	.425	.514	.619	.541	.543	.546	.621	.822	.757	.611	.563	.591
SQ9	.517	.561	.607	.579	.569	.574	.651	.898	.775	.667	.663	.646
IQ1	.520	.584	.670	.599	.600	.577	.645	.788	.857	.705	.659	.663
IQ2	.467	.523	.622	.571	.568	.565	.663	.802	.863	.655	.652	.646
IQ3	.449	.535	.604	.564	.540	.540	.654	.781	.900	.678	.611	.627
IQ4	.434	.535	.583	.552	.532	.514	.616	.729	.886	.661	.598	.664
IQ5	.413	.516	.598	.561	.475	.593	.623	.717	.867	.704	.640	.642
IQ6	.540	.579	.626	.601	.576	.629	.659	.791	.882	.684	.628	.672
IQ7	.425	.504	.572	.553	.537	.519	.626	.747	.879	.636	.578	.610
IQ8	.443	.542	.594	.545	.576	.511	.616	.723	.890	.669	.646	.650
IQ9	.427	.511	.563	.538	.554	.544	.613	.711	.872	.641	.630	.648
IQ10	.453	.519	.610	.573	.549	.589	.607	.732	.885	.713	.646	.665
IQ11	.433	.501	.627	.563	.517	.567	.627	.735	.899	.701	.648	.650
SvQ1	.431	.522	.636	.523	.535	.614	.550	.640	.716	.870	.684	.650
SvQ2	.474	.532	.663	.606	.563	.604	.654	.728	.743	.879	.738	.745
SvQ3	.372	.481	.568	.527	.462	.555	.524	.605	.660	.876	.669	.615
SvQ4	.387	.431	.555	.501	.461	.557	.488	.597	.654	.861	.589	.591

Items	TM	BP	EC	PM	TC	CM	SS	SQ	IQ	SvQ	II	OI
SvQ5	.327	.396	.507	.464	.423	.507	.446	.513	.611	.865	.579	.534
SvQ6	.451	.538	.664	.566	.547	.592	.621	.670	.697	.846	.711	.735
SvQ7	.319	.406	.554	.488	.460	.540	.502	.582	.589	.841	.613	.559
SvQ8	.424	.511	.635	.593	.530	.576	.570	.676	.675	.873	.680	.661
SvQ9	.433	.479	.615	.572	.533	.528	.536	.639	.666	.871	.662	.642
SvQ10	.399	.420	.485	.432	.416	.440	.424	.524	.586	.821	.595	.539
II1	.459	.508	.525	.507	.483	.491	.558	.680	.645	.671	.910	.731
II2	.508	.535	.566	.525	.555	.495	.584	.693	.647	.693	.927	.763
II3	.471	.535	.536	.512	.548	.491	.526	.672	.664	.697	.929	.741
II4	.506	.554	.580	.558	.578	.529	.565	.663	.670	.685	.938	.766
II5	.498	.568	.593	.583	.535	.570	.590	.679	.657	.694	.938	.798
II6	.514	.557	.600	.592	.589	.553	.588	.682	.683	.692	.933	.784
II7	.476	.532	.557	.545	.523	.524	.550	.650	.656	.715	.890	.735
II8	.397	.455	.505	.425	.427	.486	.450	.540	.597	.670	.859	.674
II9	.414	.489	.597	.502	.493	.563	.531	.619	.639	.705	.845	.684
OI2	.585	.647	.647	.627	.643	.557	.646	.657	.676	.684	.762	.902
OI3	.555	.654	.628	.628	.597	.558	.649	.648	.655	.661	.708	.890
OI4	.567	.669	.676	.645	.670	.581	.631	.619	.624	.642	.698	.870
OI7	.588	.640	.644	.641	.633	.635	.639	.652	.647	.660	.642	.824
OI8	.587	.613	.618	.608	.614	.562	.684	.633	.666	.614	.730	.887
OI9	.564	.605	.633	.618	.594	.584	.655	.615	.638	.583	.714	.871
OI10	.567	.596	.650	.646	.638	.626	.612	.592	.610	.650	.753	.881

Table 5.11: Correlations of Latent Constructs

Construct	CR	AVE	TM	BP	EC	PM	TC	CM	SS	SQ	IQ	SvQ	II	OI
TM	0.933	0.738	0.859											
BP	0.938	0.750	0.677	0.866										
EC	0.940	0.758	0.680	0.781	0.871									
PM	0.941	0.801	0.733	0.777	0.820	0.895								
TC	0.928	0.762	0.767	0.766	0.765	0.802	0.873							
CM	0.925	0.755	0.614	0.671	0.804	0.755	0.716	0.869						
SS	0.938	0.750	0.681	0.766	0.849	0.829	0.750	0.753	0.866					
SQ	0.961	0.754	0.535	0.630	0.687	0.661	0.638	0.649	0.744	0.868				
IQ	0.974	0.774	0.518	0.604	0.690	0.643	0.622	0.636	0.718	0.853	0.880			
SvQ	0.966	0.740	0.470	0.552	0.688	0.616	0.576	0.644	0.622	0.722	0.770	0.860		
II	0.977	0.825	0.520	0.580	0.619	0.583	0.580	0.575	0.606	0.720	0.717	0.761	0.908	
OI	0.958	0.766	0.655	0.722	0.733	0.720	0.716	0.669	0.737	0.721	0.738	0.734	0.818	0.875

Note: Diagonal elements are the square roots of AVE. For adequate discriminant validity, these values should be greater than the corresponding off-diagonal elements.

Legend:

TM = Top management and project championship
BP = Business plan and vision
EC = Enterprise-wide communication
PM = Project management
TC = Team composition
CM = Change management and culture program
SS = System selection and technical implementation
SQ = System quality
IQ = Information quality
SvQ = Service quality
II = Individual impact
OI = Organizational impact

5.5.2 Assessment of the Structural Model

The structural model comprises the hypothesized relationship between the latent constructs. As explained in Section 5.4.1, to assess the structural model, the following analyses are required:

i. Amount of variance explained or R squared (R^2) assessment
ii. Path coefficient and statistical significance assessment
iii. Direct, indirect, and total effects assessment
iv. Moderating or control variables assessment

Figure 5.4: The Structural Model showing Hypotheses to be tested

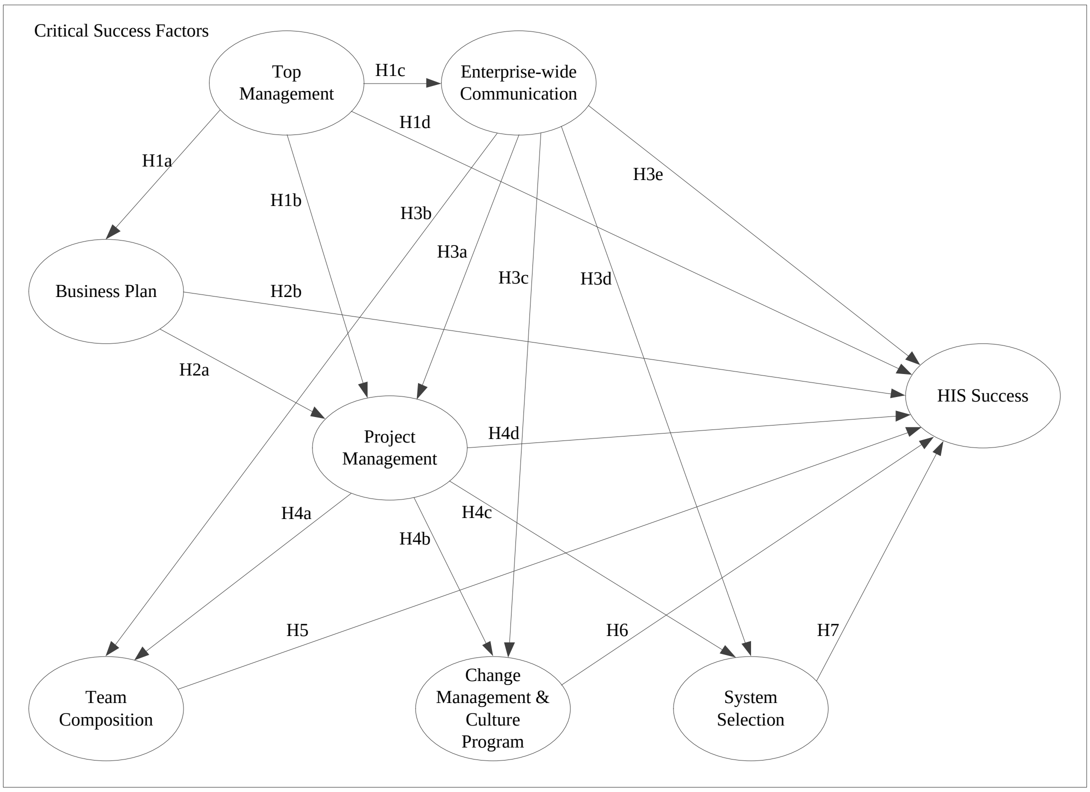


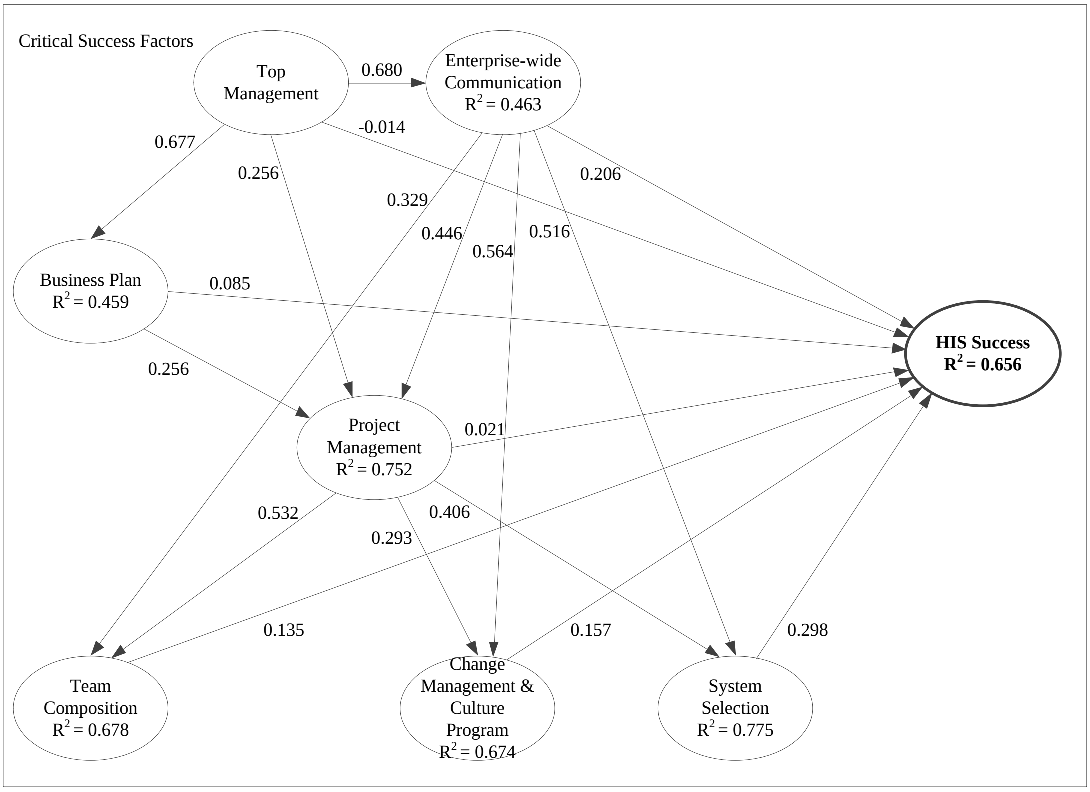
Figure 5.4 demonstrates the hypotheses of the thesis. Only 18 hypotheses are shown in the model. On the whole, there are 24 hypotheses together with the moderating hypotheses. The following sections describe the analyses in detail.

5.5.2.1 Explanatory Power Assessment

The structural model was first evaluated based on the predictive power of the model; i.e., the explanatory power of the exogenous variables on the endogenous variables.

The explanatory power was obtained by assessing the R^2 of the endogenous variables. The larger the R^2 value, the higher the predictive capability of the model. PLS-Graph was utilized to obtain the R^2 value. The results were extracted into the structural model and are presented in Figure 5.5[13].

Figure 5.5: The Structural Model Results



The R^2 value is interpreted in a similar manner to regression. Therefore, the result shows that the exogenous constructs explain 65.6% of the variance in HIS success which is the main endogenous construct for the model. The R^2 value is considered quite substantial in social sciences research (Chin 1998b; Cohen 1988). The R^2 also meets the recommended 0.10 cut-off for the latent construct to be judged adequate (Falk and Miller 1992).

[13] Explanation of the structural model results is provided in Chapter 6.

Overall, the model explained 45.9% of variance in business planning and vision, 46.3% of variance in enterprise-wide communication, 75.2% of variance in project management and 67.8% of variance in team composition. With regard to change management and culture program, 67.4% of the variance was explained and system selection showed the highest explanatory power of 77.5%. Using Chin's (1998b) recommendations as a guideline, an R^2 of 0.67 is considered as substantial, 0.33 as moderate, and 0.19 as weak. Based on the study findings, all the R^2 values appear to be between moderate and substantial, suggesting good predictive capability of the model. The R^2 values are summarized in Table 5.12.

Table 5.12: R^2 Values for the Main Model

Endogenous Constructs	R^2 Value
HIS Implementation Success	0.656
Business Plan and Vision	0.459
Enterprise-wide Communication	0.463
Project Management	0.752
Team Composition	0.678
Change Management and Culture Program	0.674
System Selection and Technical Implementation	0.775

For this section, the predictive capability (R^2) of the models was described and in the next section, the evaluations of path coefficients are presented.

5.5.2.2 Path Coefficients Assessment

Following the explanatory power or predictive power (R^2) assessment, this section examines the path coefficients (β) and statistical significance values (t-value) of all the paths. These values were extracted from the PLS-Graph bootstrapping output file. Figure 5.5 illustrates the path coefficients for every path between the exogenous construct and the endogenous construct. Nevertheless, the second order construct paths are not shown since they are not meant for prediction purposes but merely as a measurement for the second order construct. All path coefficients show positive values supporting the impact directions as postulated in the hypotheses except for top management. The *t*-values were used to test the statistical significance of the hypotheses. The results of the test are explained in the next section.

Table 5.13 Path Coefficients Assessment

Endogenous and Exogenous Constructs	**Path-*β***	***t*-value**	***p*-value**
HIS success (**R^2 = 0.656**)			
Top management and project championship	-0.0140	0.2182	0.8275
Business plan and vision	0.0850	1.0216	0.3081
Enterprise-wide communication	0.2060	2.0720*	0.0395
Project management	0.0210	0.2507	0.8022
Team composition	0.1350	2.1074*	0.0362
Change management and culture program	0.1570	1.8528	0.0653
System selection and technical implementation	0.2980	3.3028**	0.0011
Business plan and vision (**R^2 = 0.459**)			
Top management and project championship	0.6770	14.5111***	0.0000
Enterprise-wide communication (**R^2 = 0.463**)			
Top management and project championship	0.6800	15.7696***	0.0000
Project management (**R^2 = 0.752**)			
Top management and project championship	0.2560	5.2387***	0.0000
Business plan and vision	0.2560	3.6546***	0.0003
Enterprise-wide communication	0.4460	5.7382***	0.0000
Team composition (**R^2 = 0.678**)			
Enterprise-wide communication	0.3290	4.7333***	0.0000
Project management	0.5320	7.6064***	0.0000
Change management and culture program (**R^2 = 0.674**)			
Enterprise-wide communication	0.5640	6.8373***	0.0000
Project management	0.2930	3.5001***	0.0005
System selection and implementation (**R^2 = 0.775**)			
Enterprise-wide communication	0.5160	7.4784***	0.0000
Project management	0.4060	5.9194***	0.0000

Note: Significant *p<0.05, **p<0.01, ***p<0.001.

Table 5.13 reports the path coefficients (*β*), *t*-values, and *p*-values for each path in the structural model[14]. The significant paths are those with a *t*-value greater or equal to 1.96 and *p*-value below 0.05. From Table 5.13, only enterprise-wide communication, team composition, and system selection/technical implementation were found to be significant to HIS success, implying that not all hypotheses are supported. Given that some of the constructs were found to be insignificant, further direct, indirect and total effect analyses were performed.

The assessment of path coefficients assessment was presented in this section and in the next section the assessment of direct, indirect and total effects is provided.

5.5.2.3 Direct, Indirect and Total Effects Assessment

Figure 5.5 illustrates the structural model and the path coefficients (*β*). Each path coefficient represents the direct effects of the exogenous on the endogenous constructs. Additionally, the structural model can be examined for its indirect effects and total effects. Chin (1998b) asserts that the indirect effect is the product of the path coefficients along the indirect path from the exogenous to the endogenous construct and that only the significant path coefficients should be considered in the calculation.

In order to assess indirect effects, Sobel's (1982) test was used. In the case of simple mediation, the Sobel test was conducted by comparing the strength of the indirect effect of an exogenous on an endogenous construct to the null hypothesis that it equals to zero. If the result calculated from Sobel's test is greater than 1.96 then the indirect effect is considered significant.

[14] Further discussion of the path coefficients assessment is furnished in Chapter 6.

The standard error of the indirect effect is given by Sobel (1982) as

$$s_{ab} = \sqrt{b^2 s_a^2 + a^2 s_b^2}$$

In order to conduct the test, *ab* is divided by s_{ab} and this value is then compared to 1.96 (a and b are the paths' coefficients and s_a and s_b are the standard errors for the respective paths). All the values were obtained from the PLS-Graph bootstrap output. An assumption of Sobel test is that the sample size must be large. The sample size of 213 in the study was considered sufficient because there is evidence that simple mediated effects are meaningful even when the sample size is small (i.e., N = 50) (Hoyle and Kenny 1999). The analyses of the direct, indirect and total effects are presented in Table 5.14.

Table 5.14 shows that, though there is no significant direct effect from the top management on HIS implementation success construct, there is a significant indirect effect through the enterprise-wide communication construct. Likewise, the project management construct does not indicate a significant direct effect from itself to HIS implementation success. However, there is a significant indirect effect via the system selection construct.

These findings reveal that, even though top management and project management do not have a significant effect on HIS success directly, they do have a significant effect indirectly, which indicates that the two constructs are still important in HIS implementation. It could be that these constructs are well accepted and are no longer critical success factors. Further elaboration on the constructs of top management and project management is provided in Chapter 6.

The largest total effect, of 0.697, is from the enterprise-wide communication on the system selection via the project management construct. Again, this reveals that the project management construct is important indirectly. This is followed by enterprise-wide communication effect on the change management construct at 0.695. However, the results indicate that change management and culture program by itself does not pose a significant direct effect on HIS implementation success. This is rather surprising because many studies have shown that ‘change management and culture’ is vital for implementation success (Lorenzi and Riley 2004; Wu, Chen, and Greenes 2009). A detailed discussion on the change management and culture program construct is furnished in Section 6.2.2.6.

Table 5.14: Direct, Indirect and Total effects

Links	Direct	Indirect Links	Indirect	Total
TM → BP (H1a)	0.677		-	0.677
TM → PM (H1b)	0.256	TM → BP → PM	0.173***	0.429
	0.256	TM → EC → PM	0.303***	0.559
TM → EC (H1c)	0.680		-	0.680
TM → HIS (H1d)	-0.014	TM → EC → HIS	0.140*	0.126
	-0.014	TM → PM → TC → HIS	0.018	0.004
	-0.014	TM → PM → CM → HIS	0.012	-0.002
	-0.014	TM → PM → SS → HIS	0.031	0.017
BP → PM (H2a)	0.256		-	0.256
BP → HIS (H2b)	0.085		-	0.085
EC → PM (H3a)	0.446		-	0.446
EC → TC (H3b)	0.329	EC → PM → TC	0.237***	0.566
EC → CM (H3c)	0.564	EC → PM → CM	0.131**	0.695
EC → SS (H3d)	0.516	EC → PM → SS	0.181***	0.697
EC → HIS (H3e)	0.206	EC → SS → HIS	0.154**	0.360
PM → TC (H4a)	0.532		-	0.532
PM → CM (H4b)	0.293		-	0.293
PM → SS (H4c)	0.406		-	0.406
PM → HIS (H4d)	0.021	PM → TC → HIS	0.072	0.093
	0.021	PM → CM → HIS	0.046	0.067
	0.021	PM → SS → HIS	0.121**	0.142
TC → HIS (H5)	0.135		-	0.135
CM → HIS (H6)	0.157		-	0.157
SS → HIS (H7)	0.298		-	0.298

Note: The indirect effects are obtained by multiplying the coefficients of the indirect path which have significant values. Significant *p<0.05, **p<0.01, ***p<0.001.

This section has reported on the direct, indirect and total effects of the structural model. The next section describes the moderating effect of the structural model.

5.5.2.4 Moderating Effects Assessment

To understand the structural model, it is also important to analyze the effect on it of moderating variables. The literature identified gender, age, technology experience, project role, job position, and education level as possible moderating variables. Hence, a multi-group analysis was conducted to assess the moderating effects. In order to perform the analysis, the samples were first divided into two groups according to values of the moderating variable. Each group contained at least 70 samples[15] which is the minimum requirement set for PLS analysis in this study. However, age and technology experience did not meet this requirement. Given that both variables are commonly cited in the literature, an exception is made. Table 5.15 demonstrates the demographic profile for the moderating variables[16].

Table 5.15: Moderating Variables Demographic Profile

Characteristics	Item	Frequency	Percentage (%)
Gender	Male	78	36.6
	Female	135	63.4
Age	Age < 35	149	70.0
	Age >= 35	64	30.0
Technology (IT) experience	IT Experience <= 5 years	150	70.4
	IT Experience > 5 years	63	29.6
Project role	End-users	117	54.9
	Expert users	96	45.1
Job position *	Managerial	86	40.4
	Non-managerial	124	58.2
Education level	Lower (Diploma and below)	108	50.7
	Higher (Degree and above)	105	49.3

Note: * Missing responses identified for job position. N = 213.

[15] A complete explanation on sample size was provided in Section 4.6.2 of Chapter 4.

[16] Further discussion of the moderating variables is given in Section 6.2.

The data collected did not meet the assumption of normality and homoscedasticity; therefore, the Smith-Satterthwait test was applied (Chin 2004; Moores and Chang 2006). This test calculated the differences between two groups by using the following formula:

$$t = \frac{Path_{sample_1} - Path_{sample2}}{\sqrt{S.E._{sample1}^{2} + S.E._{sample2}^{2}}}$$

Manual calculations had to be made due to PLS-Graph limitations. Values for the path coefficients and standard errors were obtained from the bootstrap output file and results for the multi-group analyses are presented in Table 5.16.

By referring to Table 5.16, it appears that there are no significant effects between all the moderating variables and HIS implementation success. For gender, there seems to be a significant difference as to how males and females perceive top management and project management influencing the HIS implementation project. The male group appears to have a higher effect for both top management and project management; but for the latter, it seems that it has an opposite (negative) effect. Given that other paths show no significant effect, the overall results fail to support hypothesis H8.

With regard to the age, technology experience, and project role moderating variables, all the paths show no significant differences. Hence, hypotheses H9, H10, H11 are rejected. The result indicates that old or young, more or less technology experience, and whether they are expert-users or end-users is not relevant; all of them have the same views on how the exogenous constructs influence the HIS implementation.

As for job position, the findings indicate that those with managerial position feel that project management is a significant influence on HIS implementation. Conversely, the non-managerial category favors system selection as the important factor for a successful HIS implementation. This indicates that with or without top management support, efficient project management, effective communication, good team composition or a change management program, the main HIS system must be properly selected so that it can cater to the needs of hospitals. Again, other paths show no significant effects; as a result, hypothesis H12 is not supported.

Table 5.16: Results of *t*-test by Subgroups

Gender	**Male**		**Female**		***t*-value**	***p*-value**
	Path-β	S.E.	Path-β	S.E.		
TM → HIS	0.234	0.0975	-0.065	0.0889	2.2661	0.0245
BP → HIS	0.165	0.1280	-0.033	0.0949	1.2426	0.2154
EC → HIS	0.289	0.1421	0.214	0.0963	0.4369	0.6626
PM → HIS	-0.477	0.1965	0.104	0.1261	-2.4884	0.0136
TC → HIS	-0.046	0.1601	0.189	0.1042	-1.2302	0.2200
CM → HIS	0.238	0.1206	0.184	0.1105	0.3301	0.7416
SS → HIS	0.556	0.1728	0.247	0.1046	1.5298	0.1276
Age	**Age < 35**		**Age >= 35**		***t*-value**	***p*-value**
	Path-β	S.E.	Path-β	S.E.		
TM → HIS	0.036	0.0689	-0.028	0.1358	-0.4203	0.6747
BP → HIS	-0.026	0.0824	0.083	0.1808	0.5486	0.5839
EC → HIS	0.186	0.0911	0.293	0.2475	0.4057	0.6854
PM → HIS	0.000	0.1149	-0.112	0.2300	-0.4356	0.6636
TC → HIS	0.186	0.0795	-0.133	0.2665	-1.1470	0.2527
CM → HIS	0.188	0.1042	0.204	0.1629	0.0827	0.9341
SS → HIS	0.363	0.0979	0.473	0.2337	0.4341	0.6646
Technology Experience	**IT Exp <= 5 yr.**		**IT Exp > 5 yr.**		***t*-value**	***p*-value**
	Path-β	S.E.	Path-β	S.E.		
TM → HIS	-0.027	0.0795	0.138	0.1298	-1.0840	0.2796
BP → HIS	0.048	0.0964	0.105	0.1299	-0.3524	0.7249
EC → HIS	0.201	0.0954	0.130	0.2430	0.2720	0.7859
PM → HIS	-0.004	0.1275	-0.175	0.2390	0.6313	0.5285
TC → HIS	0.146	0.1012	0.061	0.1777	0.4157	0.6781
CM → HIS	0.257	0.1129	0.104	0.1338	0.8739	0.3831
SS → HIS	0.274	0.1092	0.482	0.1883	-0.9556	0.3404
Project Role	**End-users**		**Expert users**		***t*-value**	***p*-value**
	Path-β	S.E.	Path-β	S.E.		
TM → HIS	0.032	0.0977	0.042	0.0837	-0.0777	0.9381
BP → HIS	-0.002	0.0967	0.128	0.0997	-0.9360	0.3504
EC → HIS	0.199	0.1412	0.199	0.1142	0.0000	1.0000
PM → HIS	0.043	0.1491	-0.118	0.1887	0.6694	0.5039
TC → HIS	0.046	0.1018	0.165	0.1634	-0.6181	0.5372
CM → HIS	0.175	0.1360	0.226	0.1086	-0.2930	0.7698
SS → HIS	0.322	0.1308	0.322	0.1467	0.0000	1.0000
Job Position	**Managerial**		**Non-managerial**		***t*-value**	***p*-value**
	Path-β	S.E.	Path-β	S.E.		
TM → HIS	-0.079	0.1082	0.085	0.0801	-1.2182	0.2245
BP → HIS	0.071	0.1070	0.052	0.1054	0.1265	0.8995
EC → HIS	-0.025	0.1389	0.235	0.1289	-1.3721	0.1715
PM → HIS	0.274	0.1424	-0.185	0.1459	2.2514	0.0254
TC → HIS	0.236	0.1600	0.067	0.0966	0.9042	0.3669
CM → HIS	0.342	0.1385	0.180	0.0963	0.9603	0.3380
SS → HIS	0.114	0.1083	0.453	0.1244	-2.0553	0.0411

Education Level	Lower		Higher		*t*-value	*p*-value
	Path-β	S.E.	Path-β	S.E.		
TM → HIS	-0.114	0.0956	0.083	0.0958	1.4556	0.1470
BP → HIS	0.178	0.0917	-0.012	0.1357	-1.1601	0.2473
EC → HIS	0.266	0.1068	0.130	0.1697	-0.6783	0.4983
PM → HIS	-0.063	0.1487	-0.019	0.1770	0.1903	0.8492
TC → HIS	0.136	0.1117	0.084	0.1243	-0.3112	0.7560
CM → HIS	0.232	0.1155	0.208	0.0987	-0.1580	0.8746
SS → HIS	0.230	0.1439	0.427	0.1284	1.0215	0.3082

Degree of freedom: m+n-2. Significant *$p<0.05$, **$p<0.01$, ***$p<0.001$

In regard to education level, it seems that all the paths show no significant effect for this particular moderating variable. Therefore, the results fail to support hypothesis H13. Table 5.17 summarizes the results of the hypotheses for the moderating variables.

Table 5.17: Hypotheses for Moderating Variables

Hypotheses	Link	Result
H8	Gender*HIS	Not supported
H9	Age*HIS	Not supported
H10	TechExp*HIS	Not supported
H11	ProjRole*HIS	Not supported
H12	JobPosn*HIS	Not supported
H13	EducLevel*HIS	Not supported

5.5.3 Hypotheses Testing

Based on the path coefficients assessment, the statistical significance of the paths is determined by the *t*-values and *p*-values. Critical *t*-value at the 0.05 significant level for two-tailed test is when t = 1.96. Therefore, anything equal and above 1.96 is considered significant in this study. Hence, the results of the hypotheses are presented in Table 5.18.

Table 5.18: Hypotheses Testing Results

Hypotheses	Link	Path-β	t-value	Result
H1a	TM → BP	0.677	14.5111***	Supported
H1b	TM → PM	0.256	5.2387***	Supported
H1c	TM → EC	0.680	15.7696***	Supported
H1d	TM → HIS	-0.014	0.2182	Not supported
H2a	BP → PM	0.256	3.6546***	Supported
H2b	BP → HIS	0.085	1.0216	Not supported
H3a	EC → PM	0.446	5.7382***	Supported
H3b	EC → TC	0.329	4.7333***	Supported
H3c	EC → CM	0.564	6.8373***	Supported
H3d	EC → SS	0.516	7.4784***	Supported
H3e	EC → HIS	0.206	2.0720*	Supported
H4a	PM → TC	0.532	7.6064***	Supported
H4b	PM → CM	0.293	3.5001***	Supported
H4c	PM → SS	0.406	5.9194***	Supported
H4d	PM → HIS	0.021	0.2507	Not supported
H5	TC → HIS	0.135	2.1074*	Supported
H6	CM → HIS	0.157	1.8528	Not supported
H7	SS → HIS	0.298	3.3028**	Supported

Significant *p<0.05, **p<0.01, ***p<0.001

The findings show that the influence of top management is strongly significant on business planning (β=0.677; p<0.001), on project management (β=0.256; p<0.001), and on enterprise-wide communication (β=0.680; p<0.001). Top management does not show a significant positive impact on HIS implementation success as postulated in the hypotheses (β= -0.014; p>0.05). Therefore, only hypotheses H1a, H1b and H1c are accepted.

With regard to business planning and vision, the finding suggests that business planning has a strong significant influence on project management (β=0.256; p<0.001). On the other hand, business plan and vision do not indicate a significant impact on HIS implementation success (β=0.085; p>0.05). As a result, hypothesis H2b is not supported in the study.

For enterprise-wide communication, the findings show strong support on project management (β=0.446; p<0.001), on team composition (β=0.329; p<0.001), on change management and culture program (β=0.564; p<0.001), on system selection (β=0.516; p<0.001), and on HIS implementation success (β=0.206; p<0.05). Thus, hypotheses H3a, H3b, H3c, H3d, and H3e are supported and accepted in the study.

The influence of project management is found to be significant only on team composition (β=0.532; p<0.001), on change management and culture program (β=0.293; p<0.001) and on system selection (β=0.406; p<0.001). However, the finding fails to support the influence of project management on HIS implementation success (β=0.021; p>0.05). As a result, hypothesis H4d is rejected.

In hypotheses H5, H6 and H7, the positive effect of team composition, change management and culture program, and system selection on HIS implementation were examined. The results indicated that there was support for both team composition (β=0.135; p<0.05) and system selection (β=0.298; p<0.001) on HIS implementation success. By contrast, the change management and culture program did not show a significant impact on HIS implementation success (β=0.157; p>0.05). For this reason, only hypotheses H5 and H7 were accepted and hypothesis H6 was rejected.

5.6 Summary

In this chapter, data analysis techniques employed were discussed and analyses results presented. First, the response rate was presented, followed by discussion of non-response bias, missing values analysis, and common method bias. Next, a detailed description of the respondents' characteristics was presented, followed by an introduction to the PLS-based SEM analysis technique. For PLS analyses, there are two main analyses that must be performed: the measurement model and structural model assessment; most assessment was done using the PLS-Graph 3.0 software.

From the measurement model assessment, some indicators had to be removed in order to meet acceptable validity and reliability requirements. The final revised model confirmed that the constructs were valid and reliable which allowed for the assessment of the structural model. Evaluation of the structural model indicated that 65.6% of the variance was explained by the exogenous constructs on the endogenous construct (HIS success); this percentage was acceptable according to the social sciences research area (Chin 1998b; Cohen 1988; Falk and Miller 1992; Hair et al. 2010).

In addition to the explanatory power assessment, the structural model was assessed for path significance between all the paths defined in the model. The findings indicated that some hypotheses proposed in Chapter 3 were not accepted (refer Table 5.18). Some possible causes for the differences in the findings are presented in Chapter 6. Additionally, the structural model was tested for the direct, indirect, total and moderating effects. The results for the moderating variables suggest that there were no significant moderating effects on HIS implementation success (refer Table 5.17).

In the next chapter, the results of the statistical tests and the research model are discussed.

Chapter 6

Discussion

We learn wisdom from failure much more than from success. We often discover what will do, by finding out what will not do; and probably he who never made a mistake never made a discovery.

Samuel Smiles (1812 – 1904)

6.1 Introduction

In this chapter, the findings from the data analysis and results chapter (Chapter 5) are discussed; the intention being to discuss and reflect on:

- the factors which influence successful HIS implementation in Malaysian public hospitals,
- the relationships between the exogenous constructs [success factors],
- the effect of the moderating variables,
- the research model explanatory power, and
- the applicability of the D&M success model in measuring HIS implementation success.

The findings are compared with studies conducted outside of, as well as within Malaysia. Thus, the first section begins by deliberating on the results of the testing of hypotheses; the section is divided into three major parts. The first part examines the relationships between the exogenous variables [success factors]. In the second part, associations between the exogenous and the endogenous variables are discussed; and the last part explains the moderating effects of gender, age, technology experience, project role, job position and education level on HIS implementation.

In the successive section, the predictive capability of the refined research model is compared and contrasted with the predictive capabilities of other models reported in similar studies. The main intention is to verify that the model is indeed useful for managers to adhere to as a guideline for successful implementation. Having said this, it is not the intention of the study to claim that the proposed research model is the paramount solution for successful implementation, but that it has been demonstrated, statistically and practically, well worth consideration.

6.2 Results of Hypotheses Testing

From the review of relevant literature, a number of hypotheses concerning HIS implementation success were formulated and hypotheses tested using PLS path coefficient analyses, the estimates of *t*-values, and *p*-values. The results were found to be consistent with prior studies except in relation to the influence of top management and project championship, business plan and vision, project management, and change management and culture program. Table 6.1 compares the results of the hypotheses with prior studies. It has to be emphasized that the definition of success and measurements used in prior studies can vary from those in the current study.

The detail results of testing the hypotheses are presented in Table 6.2 and Table 6.3 respectively. Out of 24 hypotheses, 14 were supported, while others lacked sufficient statistical evidence to be accepted. The seven success factors were shown to explain 65.6% of the variances in HIS success. These results strongly suggest that the model has substantial explanatory power in predicting HIS success. Unlike the testing of hypotheses, the research model was examined using the PLS structural model assessment. A detailed discussion of the research model is presented in Section 6.3. In order to facilitate the hypotheses testing results discussion, the following sub-section describes the relationships among the predicted success factors.

Table 6.1: Hypotheses Testing Results Compared with Prior Studies

Hypotheses	Exogenous	Endogenous	Current Study	Prior Study
H1a	TM	BP	Supported	• Sawah, Tharwat, and Rasmy (2008) in Egypt: Supported. • Ramayah et al. (2007) in Malaysia: Supported.
H1b	TM	PM	Supported	• King and Burgess (2006) in UK: Supported. • Sawah, Tharwat, and Rasmy (2008) in Egypt: Supported.
H1c	TM	EC	Supported	N/A
H1d	TM	HIS/IS/ERP	Not supported	• Dezdar and Sulaiman (2011b) in Iran: Supported. • Hwang and Xu (2007) in USA: Not supported. • Kamhawi (2007) in Bahrain: Not supported. • Nah, Zuckweiler, and Lau (2003) in USA: Supported. • Nah, Islam, and Tan (2007) in Malaysia: Not supported. • Ragu-Nathan et al. (2004) in USA: Not supported. • Ramayah et al. (2007) in Malaysia: Not supported. • Sarker and Lee (2003) in USA: Supported. • Sawah, Tharwat, and Rasmy (2008) in Egypt: Supported. • Wang and Liu (2006) in China: Supported.
H2a	BP	PM	Supported	N/A
H2b	BP	HIS/IS/ERP	Not supported	• Bradley (2008) in USA: Supported. • Dezdar and Sulaiman (2009) in Iran: Supported. • Finney and Corbett (2007) in N/A: Supported. • Kamhawi (2007) in Bahrain: Supported. • Nah, Lau, and Kuang (2001) in USA: Supported. • Ramayah et al. (2007) in Malaysia: Supported.
H3a	EC	PM	Supported	• Kuen, Zailani, and Fernando (2009) in Malaysia: Supported.
H3b	EC	TC	Supported	• Kuen, Zailani, and Fernando (2009) in Malaysia: Supported.
H3c	EC	CM	Supported	• Kuen, Zailani, and Fernando (2009) in Malaysia: Supported.
H3d	EC	SS	Supported	• Kuen, Zailani, and Fernando (2009) in Malaysia: Supported.
H3e	EC	HIS/IS/ERP	Supported	• Dezdar and Sulaiman (2011b) in Iran: Supported. • Nah, Islam, and Tan (2007) in

Hypotheses	Exogenous	Endogenous	Current Study	Prior Study
				Malaysia: Supported. • Ramayah et al. (2007) in Malaysia: Supported. • Ravesteyn and Batenburg (2010) in The Netherlands: Supported.
H4a	PM	TC	Supported	• Ara and Al-Mudimigh (2011) in N/A: Supported. • Procaccino and Verner (2006) in USA: Supported. • Tsai et al. (2009) in Taiwan: Supported
H4b	PM	CM	Supported	• Kuen, Zailani, and Fernando (2009) in Malaysia: Supported.
H4c	PM	SS	Supported	• Kuen, Zailani, and Fernando (2009) in Malaysia: Supported.
H4d	PM	HIS/IS/ERP	Not supported	• Al-Mashari, Ghani, and Al-Rashid (2006) in Middle East: Supported. • Bradley (2008) in USA: Supported. • Kamhawi (2007) in Bahrain: Supported. • Nah, Islam, and Tan (2007) in Malaysia: Supported. • Ramayah et al. (2007) in Malaysia: Not supported. • Sawah, Tharwat, and Rasmy (2008) in Egypt: Supported. • Umble, Haft, and Umble (2003) in USA: Supported.
H5	TC	HIS/IS/ERP	Supported	• Al-Mashari, Ghani, and Al-Rashid (2006) in Middle East: Supported. • Bradley (2008) in USA: Supported. • Loh and Koh (2004) in UK: Supported. • Nah, Islam, and Tan (2007) in Malaysia: Not supported. • Ramayah et al. (2007) in Malaysia: Supported.
H6	CM	HIS/IS/ERP	Not supported	• Dezdar and Sulaiman (2011b) in Iran: Supported. • Nah, Islam, and Tan (2007) in Malaysia: Not supported. • Ramayah et al. (2007) in Malaysia: Supported for change readiness. • Ramayah et al. (2007) in Malaysia: Not supported for training and education. • Sawah, Tharwat, and Rasmy (2008) in Egypt: Supported. • **Note:** In this study change readiness, education and training have been grouped under the change management and culture program (CM) factor.

Hypotheses	Exogenous	Endogenous	Current Study	Prior Study
H7	SS	HIS/IS/ERP	Supported	• Al-Mashari, Al-Mudimigh, and Zairi (2011) in Middle East: Supported. • Nah, Islam, and Tan (2007) in Malaysia: Supported. • Somers and Nelson (2004) in USA: Supported.

6.2.1 Relationships among HIS Success Factors

The main motivation in the current study was to identify critical factors influencing HIS success. The relationships among the exogenous constructs [critical success factors] were also examined to answer the second research question[17] which is ***how do the CSFs interrelate with each other?*** The research question was developed to gain insights of the relationships between the success factors. By understanding the interrelationships between these factors, management could predictively anticipate the possibility of HIS implementation success. For example, if the test results imply that there are relationships and dependencies between the predictors, then the most-likely-outcome decision could be made to ensure that the factors were implemented together.

For this study, the success factors [predictors] were not tested for multicollinearity. Multicollinearity is a statistical term used when two or more predictors are highly correlated which indicates that the variable could be explained by other variables (Hair et al. 2010). The existence of multicollinearity does not reduce the predictive power or reliability of the model as a whole but it complicates the interpretation of a single predictor (Hair et al. 2010). If there is high multicollinearity between the predictors then the researcher either has to obtain more data; or drop one of the highly correlated predictors; or leave the model as it is (Hair et al. 2010). In this study, multicollinearity was not considered as a threat because the predictive power

[17] The research questions for the current study are recapitulated in Section 7.2 of Chapter 7.

of the model was examined as a whole rather than using a single predictor. Moreover, the model examination uses PLS structural model assessment as a component-based SEM variance analysis that handles measurement error.

In order to check for relationships among the predictors; correlations and PLS path coefficient analyses can be performed. The drawbacks of correlation analysis are that it does not make an assumption as to whether one predictor is dependent on another, and it cannot determine the direction of the relationships. It only reveals the degree of association between the predictors. In view of these weaknesses, the PLS path coefficient analysis was performed.

Path coefficient analyses assist in enlightening the strength of the causal relationship between two variables (Wright 1934). It is suspected that some predictors cause other predictors to occur and facilitates the comprehension on how the implementation factors reinforce each other and the direction of the relationships. For instance, if the project management is under performing, this could be due to insufficient top management support. Likewise, an ineffective project management could dampen team spirit. Table 6.2 illustrates the results of the PLS path coefficient analyses.

Table 6.2 has demonstrated that all hypotheses in regard to relationships among success factors are supported, which implies that the related factors have to be implemented together in order to get the optimal benefits out of the factors. Given the hypotheses are mostly developed from research outside of Malaysia; it seems that the findings from the Malaysian public hospitals are consistent with the literature. This could be due to several reasons as discussed in the following sub-sections.

Table 6.2: Hypotheses Testing Results for Relationships among HIS Success Factors

Hypothesis	Hypothesis Statement	PLS Path-β analysis	Result
H1a: TM → BP	Top management has a positive influence on business plan and vision.	β=0.677; p<0.001. Top management is a significant predictor of business plan and vision.	Supported
H1b: TM → PM	Top management has a positive influence on project management.	β=0.256; p<0.001. Top management is a significant predictor of project management.	Supported
H1c: TM → EC	Top management has a positive influence on enterprise-wide communication.	β=0.680; p<0.001. Top management is a significant predictor of enterprise-wide communication.	Supported
H2a: BP → PM	Business plan and vision has a positive influence on project management.	β=0.256; p<0.001. Business plan and vision is a significant predictor of project management.	Supported
H3a: EC → PM	Enterprise-wide communication has a positive influence on project management.	β=0.466; p<0.001. Enterprise-wide communication is a significant predictor of project management.	Supported
H3b: EC → TC	Enterprise-wide communication has a positive influence on team composition.	β=0.329; p<0.001. Enterprise-wide communication is a significant predictor of team composition.	Supported
H3c: EC → CM	Enterprise-wide communication has a positive influence on change management and culture program.	β=0.564; p<0.001. Enterprise-wide communication is a significant predictor of change management and culture program.	Supported
H3d: EC → SS	Enterprise-wide communication has a positive influence on system selection and technical implementation.	β=0.516; p<0.001. Enterprise-wide communication is a significant predictor of system selection and technical implementation.	Supported
H4a: PM → TC	Project management has a positive influence on team composition.	β=0.532; p<0.001. Project management is a significant predictor of team composition.	Supported
H4b: PM → CM	Project management has a positive influence on change management and culture program.	β=0.293; p<0.001. Project management is a significant predictor of change management and culture program.	Supported
H4c: PM → SS	Project management has a positive influence on system selection and technical implementation.	β=0.406; p<0.001. Project management is a significant predictor of system selection and technical implementation.	Supported

6.2.1.1 Top Management and Project Championship (H1a, H1b and H1c)

Hypotheses H1a, H1b and H1c were found to exhibit the expected direct positive influence of top management (refer Table 6.2). The finding demonstrated that top management has a positive influence on a business plan (H1a). This is consistent with prior studies that have emphasized the importance of top management being involved in business planning (Al-Mashari, Al-Mudimigh, and Zairi 2003; Deloitte Consulting 2000; Ramayah et al. 2007; Sawah, Tharwat, and Rasmy 2008). The finding implies that the involvement of top management in planning is necessary to achieve the business goals and objectives; top management can ensure that the plan is executed accordingly. If the need arise, they can deploy a contingency plan as long as the goals and objectives of the business plan are met; i.e., top management involvement can assist a smoother project transition.

Hypothesis H1b was supported, signifying that top management has a positive influence on project management. The findings are consistent with what has been stated by numerous studies on CSFs relationships (Akkermans and van Helden 2002; King and Burgess 2006; Sawah, Tharwat, and Rasmy 2008). Although the tasks of project management are to ensure that the project is executed according to the approved plan, timeline and budget, the involvement of top management is necessary to monitor and scrutinize the project management team. Being involved helps top management to understand any project hiccups and assist in resolving problems such as project delays and excess budget; top management also can be a focus factor to ensure that project management meets their objectives and deadlines.

Hypothesis H1c which proposed that top management has a positive influence on enterprise-wide communication was supported. As with other industries, communication is essential in the health industry (Dezdar and Sulaiman 2011a; Ravesteyn and Batenburg 2010). The positive finding implies that the respondents agreed that top management should be involved in promoting enterprise-wide communication. Good communication ensures that employees are well informed of project goals and have clear directions on what needs to be accomplished; it also promotes teamwork and togetherness. Therefore, top management must ensure that information is disseminated efficiently among employees, and encourage two-way communication between the management and employees. With the expansion of information and communication technology (ICT), communicating between the different departments, and in a vast working environment, is plausible through the use of emails, intranet and internet.

In Malaysia, it is common for top management to be involved in strategic business planning and project management; they are responsible for designing, prioritizing and approving projects that are beneficial for the organization. If the top management cannot be involved directly in business planning and project management, they normally have their proxies as representatives; this ensures that the management is well informed. Thus, the study results have validated the role of top management support and project championship in influencing business planning, project management and enterprise-wide communication. The findings have important implications for both HIS implementation practice and research.

6.2.1.2 Business Plan and Vision (H2a)

Hypothesis H2a, which posited that the business plan and vision has a direct positive impact on project management, was supported. Therefore, the positive result from the PLS path coefficient analysis suggests that public hospitals in Malaysia perform in ways that accord with findings from prior studies (Kuen, Zailani, and Fernando 2009; Pinto and Slevin 1989; Slevin, Stieman, and Boone 1991). An effective and clear business plan and vision can serve as a source for references for the project management team; it helps an organization to stay focused on its mission and vision. The influence of business planning on project management can ensure that the project is executed in the best interest of the organization (i.e., time, resources, financial). It also ensures that the project is implemented in line with organizational vision, goals and objectives.

Boynton and Zmud (1984) and Ross (1999) suggested that a business plan should incorporate short term and long term planning; it is also advisable for hospital management to involve all relevant personnel in the planning, especially in the case of physicians. From interviews conducted with physicians, they indicated that sometimes they were left out of the planning process due to their demanding workloads. Nevertheless, they felt that it was essential for them to be involved in the planning process because they are the ones who use the systems, not the IT personnel.

The view of some IT managers was that physicians felt that they were more superior and not interested in the IT managers' opinions, especially on technical implementation matters such as network availability, insufficient IT infrastructure, and shortage of staff. According to the IT managers, these issues were important to be resolved because uncertainty reduced the likelihood of a successful HIS implementation. Although the conflicting opinions appeared to be related to the high power distance culture cultivated in Malaysia, the lack of consensus between the two groups (physicians and IT personnel) could well jeopardize an implementation process in the long run.

Although the survey results suggest that there is a positive direct affect of business planning on project management, the findings from the interviews should not be neglected. Interview results strongly suggest that management should take action to instill cooperation and collaboration among the team members, not only during the planning stage but throughout the entire implementation process.

6.2.1.3 Enterprise-wide Communication (H3a, H3b, H3c and H3d)

Hypotheses H3 recommended that enterprise-wide communication has a direct positive influence on project management (H3a), team composition (H3b), change management and culture program (H3c), and system selection and technical implementation (H3d). From the PLS path coefficient analyses, all four hypotheses were found to exhibit a direct positive influence on enterprise-wide communication. The current research findings indicated that Malaysian public hospitals actions are consistent with recommendations in extant literature (Kuen, Zailani, and Fernando

2009; Pinto and Slevin 1989; Slevin, Stieman, and Boone 1991) where communication is a key factor in project management, team composition, change management and culture program, and system selection and technical implementation.

For H3a, the finding suggests that without sufficient communication the project management would probably have difficulty in notifying the implementation team about project schedules and deadlines, which would lead to implementation failure. To put it differently, proper communication of the project's progress, status and pending developments can be disseminated better to implementation team members. Also, potential problems and difficulties are better expressed, making it easier to be understood and resolved.

Additionally, the implementation team must have a mutual way of communicating with members from various departments; otherwise, the implementation project may not advance due to clashes of opinion. In this manner, communication could become a medium to reconcile employees thoughts (Kuen, Zailani, and Fernando 2009; Pinto and Slevin 1989; Slevin, Stieman, and Boone 1991). The positive finding H3b indicates that communication is necessary for human interactions in order to achieve a common goal.

In regard to the change management and culture program, key activities in the program are providing education and training, and ensuring user involvement and acceptance. Typically, this type of program encourages employees to accept changes by highlighting the beneficial consequences of the system. The program also reveals the goals and directions of the organization so that workers realize the need to adopt HIS. All these activities demand communication between the management and employees. Therefore, the finding H3c confirms that communication is essential to the success of the implementation program.

As postulated in Chapter 3, activities for system selection and technical implementation necessarily include proper analysis, integration, sustainable system, satisfactory user interface and acceptable system performance; all of which require either a verbal or written communication. For example, the HIS selection team should investigate what constitutes a satisfactory user interface, which could be achieved by polling users' opinions. In fact, enterprise-wide communication is vital from the early stage of setting the requirements for the system. A well-written document, for example request for proposal (RFP), assists in setting the benchmark for health information systems. It is also advisable that the RFP is written by a team of experts which understands the needs of the hospitals and its workers. The positive finding in H3d confirms the importance of enterprise-wide communication in system selection and technical implementation. From the discussion, enterprise-wide communication is accepted as indispensable for HIS success.

6.2.1.4 Project Management (H4a, H4b and H4c)

In the study, it was hypothesized that project management has a direct positive impact on team composition (H4a), change management and culture program (H4b) and system selection and technical implementation (H4c); project management is seen as an enabler for the implementation project. The research findings resulted in all hypotheses being supported, which was in accordance with prior research studies (Kuen, Zailani, and Fernando 2009; Pinto and Slevin 1989; Slevin, Stieman, and Boone 1991).

In Malaysia's Vision 2020, Malaysia has endeavored to transform its health industry to be among the best in the world. Anticipating that HIS implementation is a complex, expensive and risky project, proper planning has been laid out to minimize the risk of failure. Effective project management is part of the plan and its main purpose is to ensure that everything goes as scheduled. An effective project management would select competent team members who possess both business knowledge and technical know-how, would assign responsibilities to the team members and allocate a project manager to the team. Among the tasks of a project manager is the management of team members, resolving of any conflicts, coordinating the project, meeting project deadlines, monitoring and evaluating the project performance and making important decisions regarding the implementation project. The positive H4a result from the PLS coefficient analysis, has validated the positive effect of project management on team composition. The result is congruent with other studies on project management (Al-Mashari, Al-Mudimigh, and Zairi 2011) and confirms that project management is necessary to unite team members in order to achieve project objectives.

Coordinating the change management and cultural program is another project management task. Management needs to analyze the users' feedback, manage the users' expectations, address their dissatisfactions and provide implementation visibility to the users. The positive result of H4b (β=0.293; p<0.05) provided support that an effective project management is an important influence to the change management and cultural program. Ara and Al-Mudimigh (2011) also verified that an effective project management could lead a change management and cultural program to success. Thus, the evidence the finding demonstrates that project management is crucial for change management and cultural program success.

Project management is known to be involved either directly or indirectly in selecting suitable information systems for the hospitals and project manager need to ensure that those involved in selecting the system adhere to the guidelines that have been stipulated in the RFP; e.g., meeting the system specifications, acceptable performance, tolerable response rate and pleasant graphical user interface. Hypothesis H4c findings have demonstrated that project management does have a positive direct affect on system selection and technical implementation.

The implication of the finding is obvious, project management assists in guiding and monitoring the system selection process. Correspondingly, the importance of project management has been advocated in many studies (Al-Mashari, Al-Mudimigh, and Zairi 2011; Ara and Al-Mudimigh 2011; Kuen, Zailani, and Fernando 2009; Pinto and Slevin 1989; Slevin, Stieman, and Boone 1991).

Table 6.3: Hypotheses Testing Results for Relationships between CSFs and HIS Success

Hypothesis	Hypothesis Statement	PLS Path-β analysis	Result
H1d: TM → HIS	Continuous top management support and commitment has a positive influence on the level of HIS success in Malaysian public hospitals.	β= -0.014; p>0.05. Top management is not a significant predictor of HIS success.	Not Supported
H2b: BP → HIS	A clear business plan and vision has a positive influence on the level of HIS success in Malaysian public hospitals.	β=0.085; p>0.05. Business plan and vision is not a significant predictor of HIS success.	Not Supported
H3e: EC → HIS	An effective enterprise-wide communication has a positive influence on the level of HIS success in Malaysian public hospitals.	β=0.206; p<0.05. Enterprise-wide communication is a significant predictor of HIS success.	Supported
H4d: PM → HIS	An effective project management has a positive influence on the level of HIS success in Malaysian public hospitals.	β=0.021; p>0.05. Project management is not a significant predictor of HIS success.	Not Supported
H5: TC → HIS	A strategic team composition has a positive influence on the level of HIS success in Malaysian public hospitals.	β=0.135; p<0.05. Team composition is a significant predictor of HIS success.	Supported
H6: CM → HIS	An effective change management and culture program have a positive influence on the level of HIS success in Malaysian public hospitals.	β=0.157; p>0.05. Change management is not a significant predictor of HIS success.	Not Supported
H7: SS → HIS	Good system selection and technical implementation have a positive influence on the level of HIS success in Malaysian public hospitals.	β=0.298; p<0.05. System selection and technical implementation is a significant predictor of HIS success.	Supported

6.2.2 Relationships between HIS Success Factors and HIS Successful Implementation

Analyzing the relationship between the HIS success factors [exogenous constructs] and HIS success [endogenous construct] is most crucial in the current study because it answers the main research question; viz., ***what are the critical success factors that influence HIS implementation in Malaysia's public hospitals?*** Results from the hypothesis testing demonstrate whether or not the factors are relevant for HIS success in Malaysian public hospitals. Based on the findings, only three out of seven success factors were found significant in the Malaysian context; the result may have been triggered by different work attitudes, cultures, work processes, policies and/or procedures of the hospitals under investigation. Table 6.3 demonstrates the strength of the relationships between HIS success factors and HIS success via PLS path coefficient analyses.

6.2.2.1 Top Management and Project Championship (H1d)

The findings indicate that there was insufficient evidence to support the direct influence of top management and project championship on HIS success (H1d). This is contrary to the findings of previous studies that have shown supportive empirical evidence and emphasized the importance of the factor (Nah, Zuckweiler, and Lau 2003; Sarker and Lee 2003; Wang and Liu 2006). A possible explanation may be that the top management factor is already well understood and, having been re-emphasized many times, is taken for granted as a factor but no longer a critical one.

Top management commitment and support has been reported as indispensable in numerous studies (Bingi, Sharma, and Godla 1999; Dezdar and Sulaiman 2009; Nah, Lau, and Kuang 2001; Sumner 1999). In fact, some studies suggest that direct involvement and participation from the top management are among the most influential factors for successful project implementation because employees have acknowledged the seriousness of the matter (Akkermans and van Helden 2002; Nah, Zuckweiler, and Lau 2003; Somers and Nelson 2001; Young and Jordan 2008). Support from the top management is required especially in terms of resources, financial, moral and spiritual; without human and monetary resources, HIS implementation may not be possible. A positive climate for successful implementation must have management support, financial resources and learning orientation (Klein and Knight 2005).

Although hypothesis H1d was not supported, the current study findings are aligned with a number of studies that found top management and project championship was not significant in relation to IS implementation success (Hwang and Xu 2007; Ragu-

Nathan et al. 2004). These researchers argued that top management is still important but that its effect is indirect. After performing indirect analyses on the structural model, the findings revealed that top management and project championship does exhibit a significant indirect effect on HIS success, largely by means of its significant intermediate effect on enterprise-wide communication. Table 6.4 exhibits the indirect effects results of top management and project championship on HIS implementation. They indicate that the top management factor is indeed an important factor in an implementation project and should not be discounted.

Table 6.4: Top Management Indirect Effect Analysis

Links	Indirect	Result
H1a: TM → BP → HIS	0.058	Not Significant
H1b: TM → PM → HIS	0.005	Not Significant
H1c: TM → EC → HIS	0.140*	Significant

Note: The indirect effects are obtained by multiplying the coefficients of the indirect path. Significant **p*<0.05, ***p*<0.01, ****p*<0.001.

The assessment of the PLS structural model shows that top management and project championship accounted for 46.3% of the variance in enterprise-wide communication. This supports findings in previous studies that emphasized the importance of top management and project championship in establishing enterprise-wide communication throughout the organization (Atanasova and Senn 2011; Smith and Offodile 2008; Wang and Chen 2006). Enterprise-wide communication is vital in the daily activities of an organization and it demands greater emphasis in project implementation. The findings, then, indicated that both top management and enterprise-wide communication are crucial for HIS success.

From the demographic profile (refer Table 5.3), the majority (63.4%) of respondents that answered the questionnaire were aged between 25 to 34 years old. This indicates that they are the Gen Y workers[18]. According to several studies, Gen Y is the fastest

[18] Explanation on Gen Y birth dates was provided in Section 2.3.2.1 of Chapter 2.

growing segment of today's workforce. Most of them are digital natives, technology savvy and rely on technology in their day-to-day activities. Members of the generation are classified as achievement-oriented, team-oriented and attention-craving. They are believed to be self-motivated and have high computer self-efficacy. In other words, they are considered as computer literate or digital native (Martin 2005; Vodanovich, Sundaram, and Myers 2010; Yee 2007; Yee, Mills, and Airey 2008). Users with high computer self-efficacy are more accepting of new technology (Phansalkar et al. 2008); a possible explanation as to the reason these respondents do not perceive top management and project championship as essential for HIS success.

Moreover, the respondents' education level indicated that they are well educated. This can be determined from their demographic profile. A study by Yee (2007) also affirmed that Gen Y are the most educated generation of all time. It is possible that, because they are knowledgeable in today's technology age, they do not require the support from the top management that other employees need. From the tenure and technology experience results indicated in the questionnaire, the majority falls between one to five years. This suggests that the respondents are experienced and well aware of their responsibilities. All these factors may have influence the results in that these respondents are knowledgeable and responsible individuals who have a high sense of obligation and do not require top management and project championship intervention in order to perform their duties.

From the cultural aspects, it seems that the presence of high power distance in Malaysia ensures that the system gets implemented regardless of whether or not there is any top management support. The findings indirectly supports the Hofstede, Hofstede, and Minkov (2010) culture theory. Most Malaysian civil servants act in accordance with government policies and procedures. Due to their respect of, and commitment to, the management and the government, these workers typically comply with directions from the management without much question. In fact, respecting the elderly and the rulers are common Malaysian norms. In countries with high power distance, employees are hesitant to express their doubts due to the consequences should anything goes wrong (Nah, Islam, and Tan 2007). This is probably another explanation that substantiates the insignificance of the top management factor in the current study.

Additionally, a study by Nah, Islam, and Tan (2007) found that top management does not influence implementation success; their contention was that top management could be more important in developed countries than developing nations because most studies that suggest top management is an important factor come from developed countries. Likewise, Ramayah et al.'s (2007) finding indicates that top management does not influence successful implementation. Ramayah et al. (2007) explained that this could be due to employees' attitudes and commitment in wanting to show that they are capable of handling any given tasks. Ironically, all the studies that suggest that top management has an insignificant influence are studies from Malaysia.

From a few initial interviews with respondents, it was found that most implementation events are done with minimum intervention or supervision from top management. Respondents suspected that top management only recognizes the general idea, but not the details of the implementation process; this leads to an indifferent level of top management support. Also, there is a possibility that top management may be necessary for the implementation project but they may not affect directly the measures of HIS success such as system quality, information quality, service quality, individual and organizational impact.

Although the results imply that the top management factor is insignificant for HIS success, there is a possibility that this is due to all the success factors (CSFs) being tested simultaneously. Other factors may have lessened the effect of the top management results. In confirming this notion, the PLS structural model was reassessed by removing all the paths to HIS success except the link from top management to HIS success. In this case, the results indicated that top management alone contributes 36.3% of variance on HIS success, with a 0.602 path loading. This demonstrates that top management is significant and should be part of the implementation project.

6.2.2.2 Business Plan and Vision (H2b)

Hypothesis H2b proposed that the business plan and vision would have a positive affect on HIS success; however, the test result suggested an non-significant relationship between business planning and HIS success. The result was rather surprising and does conflict with the findings of previous studies. Past studies have shown that the business plan and vision *is* a factor that is accountable for HIS success (Bradley 2008; Dezdar and Sulaiman 2009; Finney and Corbett 2007; Nah, Lau, and Kuang 2001). In prior studies, researchers have argued that, in any project implementation, proper planning is imperative because it provides the aspiration of the organization, guidelines to what needs to be in place and allocates budgets for the expansion of the organization.

A possible explanation for the non-significant finding is because the importance of business planning is only understood at the higher level (e.g., top management). Most respondents were end-users and it is likely that they failed to see the importance of planning. It is also possible that the physicians, nurses, pharmacists, laboratory technologies, administrative and non-administrative workers overlooked the importance of planning due to their work priority and demanding workloads. They may have been too focused on day-to-day activities, accept orders or tasks readily and left business planning in the rightful hands of the top management; e.g., for physicians, the saving of human lives is their main priority compared to other matters.

Another reason for the result could be that the business plan and vision are not made explicit or visible to the workers; i.e., employees do not appreciate the relationship between business plan and vision in relation to HIS success. Given the researcher’s strong belief in the importance of planning, an indirect effect analysis was performed. The result revealed no significant indirect effect between business plan and vision in relation to HIS success. Table 6.5 demonstrates the result. As discussed in Section 6.2.1.2, business plan and vision has a direct positive impact on project management; however, the project management construct itself does not have a significant relationship with HIS success. As a consequence, this invalidates the business plan and vision indirect effect.

Table 6.5: Business Plan Indirect Effect Analysis

Links	Indirect	Result
H2a: BP → PM → HIS	0.005	Not Significant

Note: The indirect effects are obtained by multiplying the coefficients of the indirect path. Significant **p*<0.05, ***p*<0.01, ****p*<0.001.

Similar to top management, the insignificant relationship could be caused by the way HIS success was measured. Business plan and vision could be an implementation success factor, but its impact on HIS success could not be recognized due to the chosen HIS measures (i.e., system quality, information quality, service quality, individual impact and organizational impact).

Furthermore, all the success factors in the model were tested concurrently. There is a possibility that other factors may have reduced the effect of business plan and vision. If only the link between business plan and vision to HIS success remains in the PLS structural model, the result reveals that business planning contributes 47.5% of variance to HIS success with a 0.689 path loading. This suggests that business planning can be a significant success factor if other CSFs are ignored. Above all, the implication from this finding suggests that business planning should be made more visible to users. When users understand the goals and mission of the organization, they are more willing to contribute to achieve the organization's goals.

6.2.2.3 Enterprise-wide Communication (H3e)

The findings demonstrate that enterprise-wide communication is a significant influence on HIS success (H3e); this discovery is consistent with previous studies that have emphasized the importance of communication (Dezdar and Sulaiman 2011b; Nah, Islam, and Tan 2007; Ramayah et al. 2007; Ravesteyn and Batenburg 2010). Further inspection of the indirect effect analysis illustrated that there was a significant indirect effect between communication and HIS success via the system selection construct as illustrated in Table 6.6.

Table 6.6: Enterprise-wide Communication Indirect Effect Analysis

Links	Indirect	Result
H3a: EC → PM → HIS	0.009	Not Significant
H3b: EC → TC → HIS	0.044	Not Significant
H3c: EC → CM → HIS	0.088	Not Significant
H3d: EC → SS → HIS	0.154**	Significant

Note: The indirect effects are obtained by multiplying the coefficients of the indirect path. Significant *p<0.05, **p<0.01, ***p<0.001.

As discussed in Section 6.2.1.3, communication was found to have a significant relationships with other success factors such as project management, team composition, change management and system selection. This supports the importance of enterprise-wide communication across the different levels and functions of an organization. The implication of the finding suggests that communication is indispensable for implementation success. With an appropriate communication structure, issues or problems can be addressed and controlled at an early stage.

In regard to culture, Malaysia has a collectivist society[19] (Hofstede, Hofstede, and Minkov 2010) marked by strong in-group quality (tightly knit society) whereby members have close relations with their peers. This may well explain why communication was found significant in this study.

Although this factor is significant, further improvements could be made if management creates an organizational culture that promotes open communication and discussion across all levels and various functions in the organization. Open communication allows employees to be honest and more expressive; conflicts can be resolved via open communication. This leads to an increase of productivity because employees are satisfied with their working environment. A study by Hussain et al.

[19] Explanation on collectivist society or collectivism was provided in Section 3.3.2.6 of Chapter 3.

(2012) demonstrated that open communication helped to solve a nursing shortage problem.

The current situation in Malaysian public hospitals suggest that open communication is not practiced widely. This is because open communication and discussion is seen as confrontational and employees are most likely to avoid it. As with the explanations given for top management, this could be due to the high power distance. In a culture with high power distance, subordinates do not usually question their superiors. Employees tend to be more cautious to express their opinions for the fear of the outcomes. In fact, Malaysia is known for its controversial freedom of expression constitution (Ndubisi et al. 2011).

If only open communication could be accomplished, friction among the implementation team members, users and other supporting staff of the organization could be reduced. Other benefits of open communication include improve bonding between the team members; knowledge trading or knowledge sharing; knowledge exploration and teamwork. In fact, many studies have advocated the concept of open communication (Lin and Lee 2006; Oriol 2006; Pullon, McKinlay, and Dew 2009; Rad 2006).

Specifically for the implementation project, another possible way to improve communication, suggested by Dezdar and Sulaiman (2011b), is to prepare a communication plan. The communication plan should include the purpose of the implementation, benefits and project schedules. This is to ensure that everyone who is involved in the implementation project, either directly or indirectly, is well informed. With a good communication strategy, the likelihood of an implementation success is much more assured. Stok et al. (2010) suggest that an enhancement in the organizational culture in terms of the communication structure, interpersonal relationships, motivation, stimulation and values also could have a positive impact on business excellence.

6.2.2.4 Project Management (H4d)

Project management was proposed (H4d) as being positively correlated with HIS success. Unfortunately, the hypothesized relationship was not supported. This result is inconsistent with the findings of previous research in developed nations (Bradley 2008; Umble, Haft, and Umble 2003) and developing countries (Al-Mashari, Ghani, and Al-Rashid 2006; Kamhawi 2007; Sawah, Tharwat, and Rasmy 2008). To better understand the construct, an in-depth indirect effect analysis was performed. The results indicated that there was a significant indirect effect between project management and HIS success via the system selection construct. It also revealed that project management is perceived as having an influence and authority on system selection and technical implementation. Table 6.7 illustrates the results.

Table 6.7: Project Management Indirect Effect Analysis

Links	Indirect	Result
H4a: PM → TC → HIS	0.072	Not Significant
H4b: PM → CM → HIS	0.046	Not Significant
H4c: PM → SS → HIS	0.121**	Significant

Note: The indirect effects are obtained by multiplying the coefficients of the indirect path. Significant **p*<0.05, ***p*<0.01, ****p*<0.001.

Much study has promoted the concept of project management (Al-Mashari, Al-Mudimigh, and Zairi 2011; Ara and Al-Mudimigh 2011; Nah, Islam, and Tan 2007). As a result, the insignificant direct relationship was rather unexpected. A potential rationalization as to why project management does not have a direct influence on HIS success could be due to the dependency on vendors and consultants (external expertise). Most implementation work was actually done by vendors before project handover. This makes it difficult for respondents to appreciate the project management role. From an interview with an IT manager, he revealed the fact that vendors sometimes dictate to the project management in regard to following the vendors' implementation plan and project schedule. The finding adds to the literature that emphasizes vendors support and external expertise (Ifinedo 2011; Ndubisi, Gupta, and Massoud 2003; Wang et al. 2008).

Furthermore, Gen Y respondents could be a cause for the non-significance of project management. Formerly, it has been discussed that this generation is believed to be self-motivated (Vodanovich, Sundaram, and Myers 2010; Yee 2007; Yee, Mills, and Airey 2008). They do not sit and wait for project management instructions; instead, they try to manage their own tasks and responsibilities. Another possibility for the insignificance could be staff may not understand the concept of project management. Management need to provide training and awareness of project management. The insignificance could also be caused by the HIS success measurements themselves. Logically, respondents can visualize the relationship between project management and organizational and individual impact. However, it is less clear and precise to see the project management relationship with system, information and service quality.

Although the results suggest that project management is non-significant for HIS success, there is a possibility that this is caused by all success factors (CSFs) being tested simultaneously. Other factors may have dominated the influence on HIS success; specifically, system selection, team composition and enterprise-wide communication. Further analysis revealed that project management alone contributes 51.7% of variance on HIS success with a 0.719 path loading. This implies that project management is also significant for HIS success. Put succinctly, future HIS implementation should not ignore this factor.

In regard to culture, the impact of high power distance in the national culture could be a contributing factor towards the insignificant result. Due to high power distance, workers accept directives readily from the top without much objection. In fact, in many nations, large power distance seems to be the main reason why employees are less rebellious (Hofstede 1984; Hofstede, Hofstede, and Minkov 2010). In addition, most success factors were adapted from studies in developed countries such as Australia, UK and the USA. The finding from the current study suggests that a success factor like project management may be inappropriate in developing countries such as Malaysia and that further education and awareness are required. Conversely, the current study finding supports Ramayah et al.'s (2007) research which also discovered that project management has no significant influence on successful implementation.

6.2.2.5 Team Composition (H5)

The findings in this study have supported the proposed hypothesis (H5), that there is a positive relationship between team composition and HIS success. The result is consistent with prior studies in developed and developing countries (Al-Mashari, Ghani, and Al-Rashid 2006; Bradley 2008; Loh and Koh 2004; Ramayah et al. 2007).

Although team composition is significant for HIS implementation success, it is recommended that management should consider having full-time team members and back-up staff during the implementation process. This is to ensure that the project receives the utmost attention during implementation and, thereby, provide continuity and leads to a faster implementation. Similar to the concept of having full-time and part-time students, those who are full-time are more dedicated to finish their study within the allocated time period whereas part-time students have a tougher time juggling their study, work and family commitments. Back-up staff is necessary especially when there are unforeseen circumstances.

It is suggested that team members should be rewarded and recognized for their time and effort in making the project a success. From the open-ended questionnaire, the majority of the respondents complained that they were not rewarded accordingly; they had to perform their current duty and, on top of that, be involved in the implementation project. Sometimes they had to sacrifice their personal time to ensure that the implementation project progressed to completion. In the long run, employees become depressed and less motivated to complete the job done within the allocated time and budget. Thus, there must be consideration of ways to build up the team spirit and morale; encourage cooperation among the team members and sustain the team spirit; fair and equitable rewards and compensation seem to be necessary.

To improve performance, it is advisable that the team members be allowed to make fast and valuable decisions as long as the decisions have the support of all team members; by cutting bureaucratic procedures, this could save a lot of implementation time. As discussed in Section 6.2.1.4, project management has a positive relationship with team composition and ideally, the two groups should complement each other. The implementation team must be assigned with an experienced, reputable project manager or the right leader to ensure that, if there are disputes among the team members, they can be resolved with the assistance of the project manager. A project manager is required to manage the implementation team and make tougher and bigger decisions in regard to system implementation.

To summarize, even though team composition was found to be significant in this study, it can still be improved. Many studies have suggested that the implementation team should have full-time team members, cross-functional staff, well balanced business and technical competence, rewards and compensation, and the involvement of vendors and consultants. Collaborative teamwork and communication among the various team members are also necessary to ensure that they work together to achieve the common goal of implementation successfully. With adequate and competent skills, the task of implementing the system should progress smoothly.

6.2.2.6 Change Management and Culture Program (H6)

Previously, in Chapter 5 (Section 5.5.3), it was explained that the current study only accepts a hypothesis when the *t*-value is equal to or above 1.96. The *t*-value for hypothesis H6 was 1.85; therefore, the results fail to support that there is a positive relationship between change management and culture program and HIS success. In other words, the factor is not significant for HIS implementation. To a certain extent, the result is similar to the work of Ramayah et al. (2007); the only difference is in the activities defined for the change management and culture program.

It may be argued that if a one-tailed test is used, then hypothesis H6 would be significant; to be significant at the 95% confidence level, this particular test only needs the *t*-value to be 1.64 or above. Nonetheless, using a one-tailed test is inappropriate in the current study. A one-tailed test can be used only when the hypothesis states the direction of the relationship; this is not mentioned in hypothesis H6. It is also unacceptable to use the one-tailed test only for the sake of getting a significant result which would lead to an invalid result interpretation which is highly questionable.

Major activities under the change management and culture program are education and training. It is anticipated that when users are given adequate education and training, they are more willing to accept a newly implemented system. Prior studies suggest that both education and training advances users' knowledge, making it easier for them to perform their daily tasks and activities (Aladwani 2001; Lorenzi and Riley 2004; Wu, Chen, and Greenes 2009). For example, through training, employees can learn to use the latest high-tech hospital equipment. Therefore, reasons for the unanticipated result in the current study were considered.

One probable reason may be that the particular program was not executed successfully by the management, thereby making the users devalue its benefits. In other words, the change management and culture program was not effective and helpful. As in previous discussion, some insignificant results could be caused by lack of education and awareness. A change management and culture program is meant to prepare the workforce for the upcoming changes such as managing and handling a new HIS. It is intended also to aid staff in overcoming their fear and anxiety. Unless the program was delivered effectively, users may not have realized its advantages. The management may need to improve the program by making it more interesting, better resourced and directly related to the users' work tasks.

The above claim could not be proven in this study. Firstly, the design of the questionnaire was not planned to measure the execution of the change management and culture program itself. Secondly, even if the design of the questionnaire managed to capture this element, the respondents may be reluctant to answer sensitive questions to protect their own interests. A case study approach might be more suitable to confirm this type of occurrence.

Another plausible rationale could be related to the national culture, particularly power distance in the organization. In countries where power distance is high, employees tend to accept directions from higher authorities without much complaint or enquiry. Malaysia is one of the countries with high power distance, so there is a possibility that the civil employees in Malaysian public hospitals simply accept orders to adopt a new system without noticing and realizing the worth of the change management and culture program.

From a statistical perspective, if only the change management and culture program is tested with the HIS implementation success variable, there is a high probability that the result could be significant. Pursuing this notion, the results revealed that change management alone contributes 50.1% of variance on HIS success with a 0.708 path loading. This implies that change management is significant in HIS success. Nonetheless, there are six other factors that must be tested alongside the change management and culture program. The other factors may have reduced the effect of change management and culture program on HIS success.

The majority of the respondents were digital natives or computer literate; otherwise known as Gen Y. This generation prefers to learn by doing instead of receiving training (Berk 2009) which often is considered irrelevant (Yee 2007); Gen Y adapts to changes swiftly and easily as compared to older generations (Gardner 2006) and they are technology savvy (Vodanovich, Sundaram, and Myers 2010; Yee 2007; Yee, Mills, and Airey 2008). From the characteristics of Gen Y, it may be suggested that the change management and culture program is incongruous for this new workforce lineup.

6.2.2.7 System Selection and Technical Implementation (H7)

System selection and technical implementation was hypothesized (H7) to be a positive influence on HIS success. As predicted, the findings supported the hypothesis; a result consistent with previous studies that considered this factor (Al-Mashari, Al-Mudimigh, and Zairi 2011; Nah, Islam, and Tan 2007; Somers and Nelson 2004). In selecting the right system for the organization, utmost consideration and attention must be given in order to ensure that the system meets if not all but most of the users' requirements.

From the preliminary interviews with some hospital IT managers and employees who were involved in selecting the system, they reported feeling that the hospital IS systems are not state-of-the-art or cutting-edge technologies. This is because system requirements are conducted two to three years prior to implementation. By the time a system is implemented, it may no longer meet the current requirements. The reason for a long lead time with the requirements is that hospitals have to acquire budgets from the government and this process requires proper documentations and takes time.

Thus, it is critically important that those involved in selecting the system should be technically equipped (in both hardware and software) and well informed about the evolving technologies; e.g., by proposing an expandable storage system and mandating vendors to propose a modular system. A modular system is easier to customize and expand (Khong and Ren 2011; Shamsuzzoha 2011). Having a robust, modular would allow hospitals to be cost-effective because this systems are more usable, serviceable and sustainable (Khong and Ren 2011; Shamsuzzoha 2011). Rigid systems are usually expensive to be customized because they are maintained by the vendor and quickly become outdated.

Interviews with the head of forensics and pathology from the participating hospitals revealed that they preferred voice recognition systems. With a voice recognition or voice command system, performing an autopsy would be much easier because all the activities could be recorded instantly; pathologists, too, favor this type of system because it makes their task of diagnosing diseases faster. The current system only accepts keyboard entry which is tedious and time consuming; by the time physicians are free to enter the necessary information, some parts of the postmortem or experiment can be overlooked or forgotten. Part of the problem can be caused when the system requirements were identified; these kinds of systems were either not available or extremely expensive. Thus, this is the reason why those involved in selecting the system, should foresee what is required and the availability of the latest technologies. Similarly, they should be aware of the difficulties hospital staff are facing in order to ease their workloads.

Another issue with out-of-date systems is the support from vendors. Vendors normally stop their maintenance support with outdated systems within a few years. This is to encourage users to buy new systems. Eventually, if users request support for old systems, then the charges will be steep. HIS systems are expensive and their implementation time-consuming, so it is very important for users to request vendors to provide at least five or more years maintenance support in order to gain from their investments. In summary, because system selection and technical implementation was found as the most significant factor in this study, it is essential to build improvements into future HIS implementation.

6.2.3 The Moderating Variables of HIS Success

The main purpose for examining moderating variables is to understand the inconsistencies of results across a study. Moderating variables can neutralize, enhance or lessen the effect of a relationship (Howell, Dorfman, and Kerr 1986); also, they can unveil the limitations of explanatory powers (Sun and Zhang 2006). Therefore, before making any concluding remarks about the research findings, it was important to understand the effect of the moderating variables in this study. A multi-group analysis was used for the moderating effect assessments. The complete multi-group analyses results have been presented in Table 5.16 of Chapter 5. Table 6.8 summarizes the results for the moderating variables. It appears that there are no significant effects between all the moderating variables on HIS implementation success. The succeeding sub-sections discuss the effect of moderating variables on HIS success.

Table 6.8: Hypotheses Testing Results for the Moderating Variables

Hypothesis	Hypothesis Statement	Result
H8: Gender*HIS	Gender moderates the level of HIS implementation success in Malaysian public hospitals.	Not Supported
H9: Age*HIS	Age moderates the level of HIS implementation success in Malaysian public hospitals.	Not Supported
H10: Technology experience*HIS	Technology experience moderates the level of HIS implementation success in Malaysian public hospitals.	Not Supported
H11: Project role*HIS	Project role moderates the level of HIS implementation success in Malaysian public hospitals.	Not Supported
H12: Job position*HIS	Job position moderates the level of HIS implementation success in Malaysian public hospitals.	Not Supported
H13: Education level*HIS	Education level moderates the level of HIS implementation success in Malaysian public hospitals.	Not Supported

6.2.3.1 Effects of Gender (H8)

In the current study, gender was hypothesized (H8) as having a moderating effect on HIS success. In order to confirm that gender has a significant moderating effect on HIS success, all relationships in the multi-group analysis must be significant. Given that only two (top management and project management) out of seven relationships were significant, the conclusion is that gender does not have a significant moderating effect on HIS success. Hence, hypothesis H8 is not supported.

Initially, hypothesis H8 was formulated because prior studies have found that gender could moderate relationships in a research model (Minton and Schneider 1980; Morris, Venkatesh, and Ackerman 2005; Venkatesh and Morris 2000). For example, in Venkatesh et al.'s (2003) study, there was empirical evidence that gender has a profound impact on individual attitudes; men and women not only differ by nature, but they have different ways of thinking. Both genders had salient differences in what they perceived as important in adopting technology (Venkatesh and Morris 2000).

Realizing that the overall results were insignificant, a detailed inspection on each and every relationship was conducted. The results indicated that men considered top management and project management were imperative for HIS implementation success. A possible justification could be that men associate more with the leadership or supremacy notion since they have been instilled with this belief since young; the idea of having power or control has always been important for men. In most cultures, men are believed to be better than women in management and leadership (Bosak and Sczesny 2011; Eagly and Karau 2002; Koenig et al. 2011; Prime et al. 2008).

Another possible reason could be that, compared to men, women are more people oriented and concerned about people's wellbeing (Su, Rounds, and Armstrong 2009). The women probably felt more conscious of factors such as teamwork or team collaboration as being important for project success. If team members can work well with each other, then project implementation is likely to be more successful. Further analysis was conducted to confirm this notion. The results from the analysis revealed that the female path coefficient (β=0.189) is slightly higher than the male (β=-0.046). However, this result alone was not enough to prove that there is a significant moderating effect for team composition. The Smith-Satterthwait test was then applied and the result confirmed that there was no gender moderating effect between team composition and HIS success.

Despite the insignificant finding, it is worth recognizing the impact of gender; e.g., a study by Eagly and Carli (2003) suggested that, due to women's concerned with human nature, having women leaders in today's working condition can be effective. Future implementation projects may want to exploit the strengths and traits of both males and females.

6.2.3.2 Effects of Age (H9)

The current study hypothesized (H9) that age moderates the effect of the success factors on HIS implementation (refer Section 3.3.3.2). To evaluate the moderating effects, the respondents were split into two groups. The first group consisted of those who were 35 years old and above, and the second group was for those less than 35 years old. From the multi-group analysis, the findings lacked evidence to support the hypothesis; nor did they support previous studies that have shown younger workers are more adaptable to change and adapt to new technology more easily (Gardner 2006; Vodanovich, Sundaram, and Myers 2010).

A potential explanation could be that despite age differences, both the younger and the older workers performed their duties without much resistance. This could be caused by the high power distance in the Malaysian organization where workers merely accept directions from the top (Hofstede 1980; Hofstede, Hofstede, and Minkov 2010). The result also contradicts findings from Morris, Venkatesh, and Ackerman (2005) which suggest that older workers are reluctant to change.

Irrespective of the finding, it was wise to identify effective methods to avoid age stereotyping (i.e., older workers are less productive, less motivated, less adaptable, etc.). If possible the management should find ways to have a resilient workforce by retaining their older workers so that they become valued and respected members of the workforce (Posthuma and Campion 2009). Likewise, the younger workers should be encouraged to learn from the older workers.

6.2.3.3 Effects of Technical Experience (H10)

In Chapter 3, it was hypothesized (H10) that technical experience has a significant moderating effect on HIS success and to test the moderating effect of technical experience, the respondents were divided into two distinct groups. The first group comprised respondents with five years and less of technology experience; and the other group is for those with more than five years of experience. The findings did not support the hypothesis and were inconsistent with prior studies (Compeau and Higgins 1995b; Igbaria and Iivari 1995).

In many instances, where the users have many years of technical experience, the chances of implementing HIS successfully would be higher because experienced users have less anxiety or fear when dealing with new technology. Based on their experience, they know what to expect and are able to provide ways of improving the implementation process. Naturally, the more technical experience one has, the higher the computer self-efficacy (Compeau and Higgins 1995b; Igbaria and Iivari 1995). However, the results of the current study indicated otherwise. Irrespective of the technical experience, there was no significant moderating effect on HIS success.

A potential explanation for the non-significant moderating effect could be that HIS, unlike any other system, implementations are complex and challenging. Many studies have highlighted the intricacy of HIS implementation (Aarts, Doorewaard, and Berg 2004; Berg 2001; Littlejohns, Wyatt, and Garvican 2003). Consequently, even though a person may have many years of technical experience, there might still be some uncertainties about the entire implementation process. This probably explains why, regardless of the years of employment, technical experience does not have a significant impact on the result.

There is also a possibility that the employees, despite their technical experience have insufficient expertise to maintain the technology. For instance, there are many applications or modules in HIS; one may be well-versed in a certain area such as pharmaceutical, but not in radiology. Indirectly, this view supports Bulgiba's (2004) study that asserts Malaysia's main problem in adopting HIS is due to inadequate skilled resources to operate and maintain the technology and a lack of experience in the use of IT in healthcare. In other words, technical experience alone is insufficient to test the moderating effects. There is a possibility that business know-how should also be incorporated during the moderating effect analysis. Unfortunately, the survey did not capture how much knowledge employees had in regard to the system and business operations. This limitation should be addressed in the future work on HIS implementation.

Another possibility for the non-significant moderating effect could be that the respondents are overly reliant on vendors and do not fully utilize their own technical experience. In Malaysia, it is common to see 'users' depending on 'vendors'; the main reason being that employees do not want to be responsible if something goes awry. Indirectly, this finding supports other studies that have emphasized external expertise; namely, vendors and consultants (Ifinedo 2011; Ndubisi, Gupta, and Massoud 2003).

Despite the overall outcome suggesting that there was no significant technical experience moderating effect, further inspection on the multi-group analysis revealed that those with less than five years of technical experience regard top management support as imperative for project management. Conversely, those with more than five years of experience consider top management support as crucial for enterprise-wide communication. To recapitulate, system selection has the highest loading on HIS success followed by enterprise-wide communication; thus, the finding amplifies the importance of enterprise-wide communication for HIS success.

6.2.3.4 Effects of Project Role (H11)

Based on past research, there should be a moderating effect for different types of project role (Tang and Yang 2005). Hence, hypothesis H11 proposed that different project roles have a significant moderating effect on HIS success. In the current study, there were six types of project roles (viz., project champion, end-user, vendor, director, key-user, and technical advisor). In order to perform the multi-group analysis, the roles were divided into expert users and end-users. Apart from the end-users' role, all other roles were classified as expert users. The two types of users or roles do not have the same level of expertise, so it was projected that expert users heighten the effect of HIS success.

The result from the multi-group analysis indicated that there is no difference between the experts and end-users. Regardless of their expertise, both groups seem to have the same influence on HIS success; hence, hypothesis H11 was not supported. A possible explanation could be that the HIS implementation projects are mostly handled by vendors until time for project handover. Even after project handover, external expertise is available until the system is classified as stable by the users. Even though hypothesis H11 was not supported, the finding supports the importance of external expertise, particularly when implementing complicated systems (Ifinedo 2011; Wang et al. 2008).

6.2.3.5 Effects of Job Position (H12)

Hypothesis H12 posited that different job positions have a significant moderating effect on HIS success. To test this hypothesis, respondents were divided into two distinct groups; managerial and non-managerial. It was believed that those who are holding the managerial positions are more enthusiastic to enhance the system implementation due to their high commitment and sense of responsibility. The finding revealed that job position (managerial versus non-managerial) does not have a significant moderating effect on HIS success; thus, hypothesis H12 was not supported. The result contradicts past studies that have shown that different job positions could moderate the effect on HIS success (Schaper and Pervan 2007b; Witt 1993).

Further investigation of each of the relationships in the multi-group analysis revealed that those having the managerial position deemed project management as imperative for HIS implementation success. This finding supports earlier studies that have shown project management is vital for HIS implementation success (Al-Mashari, Ghani, and Al-Rashid 2006; Bradley 2008; Kamhawi 2007; Sawah, Tharwat, and Rasmy 2008; Umble, Haft, and Umble 2003).

Conversely, the non-managerial group favored system selection and technical implementation factors as imperative for HIS success. This finding suggests that the non-managers preferred having a good, reliable system. Here, the Gen Y impact could be observed. As discussed in Section 6.2.2.1, these younger workers are more technically savvy and prefer exploring the system rather than being given orders. Thus, it is not surprising that they prefer a better system compared to other factors. This also indicates that persons in different job positions may have different opinions on what factors contribute to a successful HIS implementation. In fact, their different viewpoints could be a research study in itself.

Formerly, in Section 6.2.2.4, potential reasons why project management was found non-significant for HIS success were discussed. Based on the job position moderating effect finding, another possibility for the non-significant result could be due to the job positions of respondents. The majority of the respondents, being non-managerial, may not have appreciated the importance of project management as compared to system selection and technical implementation. The finding suggests that different groups of users have different perceptions towards HIS implementation and these perceptions must be managed accordingly.

6.2.3.6 Effects of Education Level (H13)

Prior studies have shown that education level is a potential moderating variable that could influence implementation success (Agarwal and Prasad 1999; Park, Yang, and Lehto 2007; Smith, Collins, and Clark 2005; Weijters et al. 2007). Following indications from earlier studies, it was hypothesized (H13) in this study that education level moderates the influence of HIS success. To test the moderating effect of education level, the respondents were divided into university and non-university levels. Degree or higher degree holders were placed under the university levels and the rest were grouped under non-university levels. Nonetheless, after performing the multi-group analysis, the findings failed to support hypothesis H13.

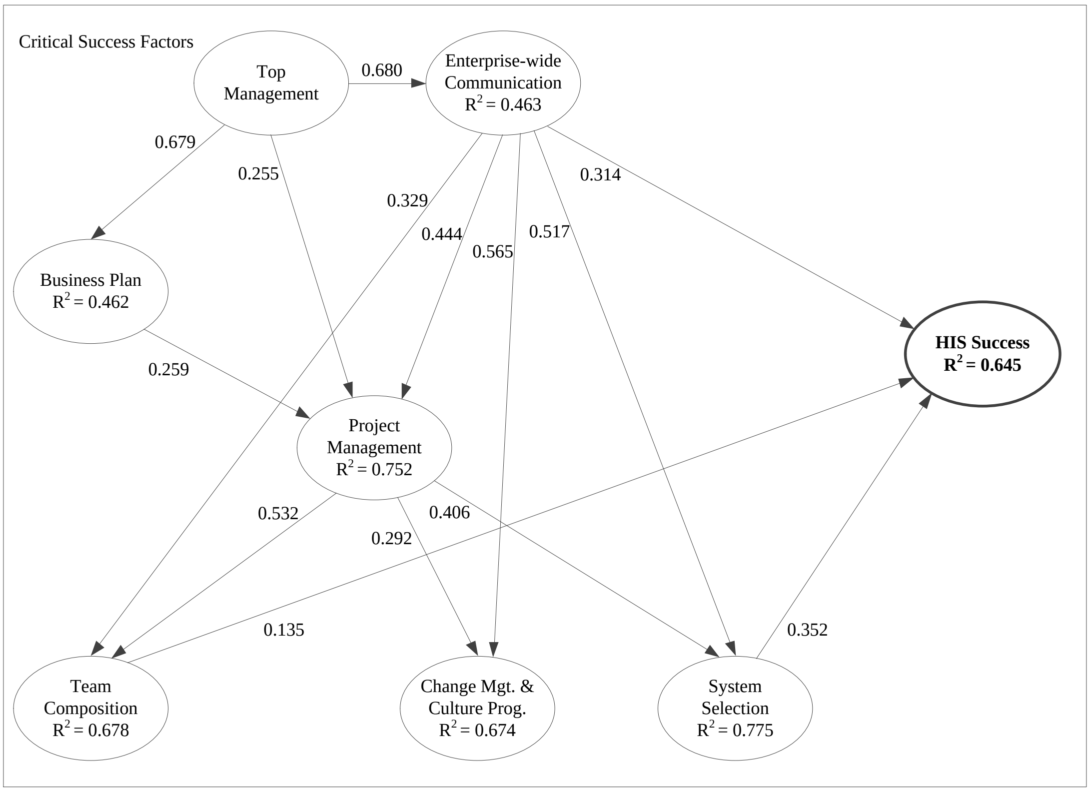
The result suggests that, regardless of education level, both groups are indifferent about factors influencing HIS implementation. Analogous to the justifications given for the other factors, the non-significant moderating effect could be caused by the dependency on external expertise or vendors. HIS implementation is often a risky and expensive operation, so leaving the implementation in the hands of experts is the wisest thing to do. In fact, it would be easier for management to pinpoint the vendors should anything go wrong. This justifies the non-significant moderating effect of education level. Also, the finding adds to the literature that signifies the importance of external expertise in implementation projects (Ifinedo 2011; Ndubisi, Gupta, and Massoud 2003).

6.3 The Research Outcomes Model

The research outcomes model in this study was developed to elucidate the relationships between constructs, the direction of the relationships and the theory underlying these relationships. In addition, the model helped to answer the research questions. From the data analysis, only three factors had a significant influence on HIS success; viz., team composition, enterprise-wide communication and system selection. Among the three, system selection and technical implementation is the most dominant factor to influence HIS success. This implies that majority of the respondents agreed that selecting an appropriate HIS system is vital for HIS success.

No matter how remarkable a system, it is bound to fail if users refuse to utilize it. Ultimately, technical factors alone are not sufficient for HIS success. It is also necessary to include the socio-technical factors into the research model. The socio-technical factors used in this study were team composition and change management. Figure 6.1 depicts the research outcomes model.

Figure 6.1: The Research Outcomes Model with Significant Paths



6.3.1 Comparison with Other IS Implementation Studies

The explanatory power of the final outcomes model was compared to prior studies that have adopted the D&M IS success model to explain IS implementation success. Initially in Section 5.5.2.1, the HIS success explanatory power was 65.6%. In Figure 6.1, the HIS success R^2 value is 64.5%. The slight drop of the R^2 value is due to the removal of the four relationships; top management, business plan, change management and system selection to HIS success. The explanatory power for the other endogenous constructs remained the same.

The research outcomes model demonstrates a high explanatory power of 64.5% when compared with extant literature. The high explanatory power could be due to the incorporation of critical success factors that are comprised of both technical and socio-technical factors. Table 6.9 demonstrates past studies that have used D&M to measure IS success. Unlike the current study that utilized almost all D&M constructs, past studies only used certain D&M constructs.

Table 6.9: Comparison with Other IS Implementation Studies

Authors	Study	Setting	Country	Constructs Considered	R^2
Thong (2001)	IS implementation for small businesses	Small businesses	Singapore	Implementation factors and D&M constructs	0.26
Wixom and Watson (2001)	Data warehousing implementation	Multiple organizations	USA, South Africa, Canada, Austria	Implementation factors and D&M constructs	0.37
Wang and Liao (2008)	eGovernment systems	Citizens	Taiwan	Implementation factors and D&M constructs	0.40
Ifinedo (2008)	ERP systems implementation	Private organizations	Finland, Estonia	Implementation factors and D&M constructs	0.17
Wang (2008)	E-commerce applications	Organizations	Taiwan	Implementation factors and D&M constructs	0.64
Ifinedo (2011)	ERP systems implementation	Private organizations	Sweden Finland	Implementation factors and D&M constructs	0.69
Abdullah (2012)	HIS implementation	Public hospitals	Malaysia	Implementation factors and D&M constructs	0.65

From the review of the literature, it appears that many studies in Malaysia have adopted or extended the D&M IS success model (Hussein, Abdul Karim, and Selamat 2007; Murali, George Patrick, and Raduan 2010; Ramayah, Ahmad, and Lo 2010). However, none of the studies has amalgamated the critical success factors and the D&M IS success model to explain IS implementation success; thus, the current research is unique compared to other studies and contributes to the literature on empirical research.

6.4 Summary

This chapter has been used to compare the findings of this study to those in extant literature. It began with a clarification of the relationships between the success factors and by making the relationships explicit, it aids management in planning future implementation projects. Then, the relationships between the exogenous and endogenous constructs were discussed and only three out of seven factors were found to be significant for HIS success; viz., enterprise-wide communication, team composition, and system selection and technical implementation which had the highest significance. Hence, from the survey results, choosing a suitable system was the most important criteria for HIS success. The moderating effect was discussed next and all moderating variables (i.e., gender, age, technical experience, expert users' vs. end-users' project roles, job position (manager vs. non-manager), and education level) were found to be non-significant.

Subsequently, the research outcomes model's predictive ability for HIS success was compared with prior studies from developed and developing countries. Unfortunately, the model could not be compared with past Malaysian studies that had tried to explain HIS implementation success. Prior studies either attempted to explain the issues of implementation or the infrastructure of HIS and most studies were exploratory. Thus, it was not possible to compare the explanatory power of the current study research model with other Malaysian studies. The final research outcomes model indicates considerable explanatory power and is worthwhile for use in further investigation. A refinement of the research model is highly suggested for future research work.

The next chapter provides the conclusion of the study, with a final examination of the research question, the research implications, study limitations and opportunities for future research being presented.

Chapter 7

Conclusion, Implications and Future Work

It is a mistake to suppose that men succeed through success; they much oftener succeed through failures. Precept, study, advice, and example could never have taught them so well as failure has done.

Samuel Smiles (1812 – 1904)

7.1 Introduction

The intention in this study was to refine the concept and practice of HIS implementation. Despite technological advances, the success level of HIS implementation is still disappointing. In addition, there has been limited academic research that has systematically and rigorously investigated hospital implementation success, particularly in Malaysian settings. Malaysia, as a growing nation, strives to provide high quality healthcare services and one of the means to achieve this objective is to integrate ICT [HIS] into the sector. Unfortunately, the integration process has not been as seamless as it should be. Many things have to be considered; from planning, resource allocation, employees' readiness, infrastructure preparation, actual implementation and the acceptance of the system. For this reason, the current study was designed to investigate the key factors that can influence a successful HIS implementation process.

In the concluding Chapter 7, the study contributions and limitations have been summarized and an overview of potential future research work provided. First, the research questions that guided this study are re-visited, followed by a brief discussion on how the questions were resolved. In the succeeding section, the contributions of the current study are presented. Subsequently, the limitations of the research study are discussed and the chapter concludes with suggestions of future research possibilities.

7.2 Re-visiting the Research Questions

The current study was instigated based on the need to understand the key implementation factors that could enhance a successful HIS implementation in Malaysian public hospitals. In order to address this issue, the major research question was:

What are the critical success factors that influence HIS implementation in Malaysia's public hospitals? In addition, three further questions were posed:

1. How do the CSFs interrelate with each other?
2. How and to what extent do CSFs influence HIS implementation?
3. What are the effects of moderating variables to HIS implementation framework?

There were numerous studies that directly or indirectly addressed critical success factors for IS implementation. Given that HIS is also a part of information systems (IS) and enterprise systems (ES), literature from these domains also were explored. To answer the major research question, the success factors that enhance HIS implementation were identified through a synthesis of extant literature. The details of the synthesis process were described in Section 3.3.2. From the synthesis it was determined that the critical success factors could be grouped into seven categories, which are:

1. Top management and project championship
2. Business plan and vision
3. Enterprise-wide communication
4. Project management
5. Team composition
6. Change management and culture program
7. System selection and technical implementation

The above list was in no particular order. Apart from the literature, a series of interviews with a few expert users from the Ministry of Health were also conducted.

They gave constructive suggestions by adding and deleting some measurement items for the above factors [constructs]. Furthermore, the MOH expert users made amendments on some chosen words [terms] and sentence structure so that a developed questionnaire could be interpreted easily by the respondents. They did not provide any remarks to include additional constructs to the research model. As a result, the seven constructs remained throughout the study.

The testing of hypotheses (H1 to H7) helped to answer the first supporting research question. The results of the tests were described in Section 5.5. The final findings suggested that only three out of the seven factors were statistically significant in enhancing HIS implementation. Based on the results of this study, it was concluded that team composition, enterprise-wide communication and system selection and technical implementation were identified to demonstrate strong, direct positive effects on HIS implementation success in Malaysian public hospitals employing THIS.

The unanticipated findings were that top management, business plan, project and change management were found to be statistically non-significant in relation to HIS implementation success; therefore, they were investigated further. From the direct, indirect and total effects analysis, it was discovered that top management did have a significant indirect effect on HIS implementation success by means of its intermediate affect on enterprise-wide communication. Correspondingly, project management was also found to have a significant indirect effect on HIS implementation success via its intermediate affect on system selection and technical implementation. These results imply that both constructs are essential in HIS implementation.

Unfortunately, the indirect effect analysis of business planning and change management did not reveal any positive findings. Possible justifications for the inconsistency of the findings with the literature were discussed in Section 6.2 of Chapter 6. The major reason for the absence of the indirect effect on HIS implementation may have resulted from the research model structure itself. However, in this study, change management did not have any intermediate variable leading to HIS success.

Further examination of the success factors indicated that these factors were actually interrelated, where one factor could not function optimally without the existence of the other. Thus, the second supporting research question was answered by a series of hypotheses as formulated in Section 3.3.2 of Chapter 3, followed by the testing of the hypotheses in Chapter 5 (Section 5.5.3). The test results suggested that all the hypotheses concerning the relationships between the success factors were supported statistically. It was concluded that the links among the success factors should not be discounted in order to reach optimum HIS implementation benefits. The details of the hypotheses were then discussed in Section 6.2.1 of Chapter 6.

To complete the investigation, the current HIS implementation was evaluated. The purpose of the assessment was to discover whether the users were contented with the existing system and whether there were things that could be improved further. If the users were satisfied, then it was considered that the HIS implementation was a success and vice versa. Given that success itself has a broad definition, the current study adopted the D&M IS success model to measure the implementation success. Not all D&M model attributes were utilized. Section 3.2 of Chapter 3 provided justification for the dimensions that were used in the study. Hence, the answer to the third supporting question was achieved.

Although the overall results suggest that HIS implementation was successful, hospital management should not take HIS success as an indication of complete satisfaction. It is important to highlight that there are various aspects that can still be improved. For example, promoting open communication and discussion such that all problems and complaints can be heard and resolved. Studies by Malhotra, Ndubisi, and Agarwal (2008) and Ndubisi et al. (2011) revealed that, generally, the Malaysian culture does not encourage openness to avoid confrontation. Malaysians would rather complain to colleagues, friends or families members about their dissatisfaction at their work than to the management. If management cannot instill openness among the employees, it is most likely that system enhancements will be restricted.

Figure 7.1 demonstrates the final research outcomes model of this study. The evidence reveals that only three constructs were found to have a significant influence on HIS success with system selection and technical implementation having the highest influence. Management would be well advised to focus on these factors so that HIS implementation can be improved further. The inference of the final research outcomes model suggests that top management is required to oversee business planning, project management and enterprise-wide communication. Similarly, project management must administer the change management and culture program, determine team composition, and exercise system selection. Finally, enterprise-wide communication must be instilled at all levels of the organization.

Figure 7.1: Final Research Outcomes Model

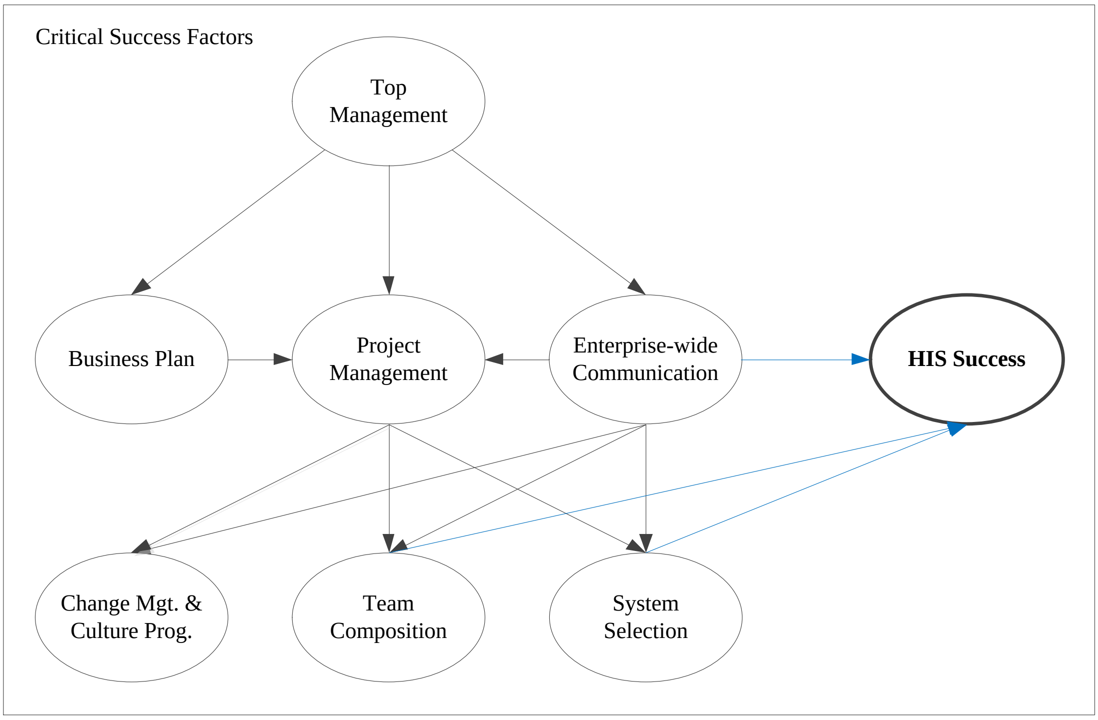


Table 7.1 contains a summary of the research questions and their resolution.

Table 7.1: Summary of the Research Questions

Research Questions	Conclusion
<u>Major Research Question</u> What are the critical success factors (CSFs) that influence HIS implementation?	Based on a synthesis of the relevant literature and a series of interviews, the following success factors are identified (Section 3.3.2, Chapter 3): • Top management and project championship • Business plan and vision • Enterprise-wide communication • Project management • Team composition • Change management and culture program • System selection and technical implementation

<u>Supporting Research Question 1</u>
 	
How do the CSFs interrelate with each other?
	Based on the results of the hypotheses testing, the following relationships between the CSFs are explained and supported (Section 6.2.1, Chapter 6):
	• Top management and project championship and
	    o business plan and vision
	    o project management
	    o enterprise-wide communication
	• Business plan and vision and
	    o project management
	• Enterprise-wide communication and
	    o project management
	    o team composition
	    o change management and culture program
	    o system selection and technical implementation
	• Project management and
	    o team composition
	    o change management and culture program
	    o system selection and technical implementation

<u>Supporting Research Question 2</u> How and to what extent do CFSs influence HIS implementation?	Based on the results of the hypotheses testing, the final success factors are as follows (Section 6.2.2, Chapter 6): • Enterprise-wide communication • Team composition • System selection and technical implementation

Research Questions	Conclusion
<u>Supporting Research Question 3</u> What are the effects of moderating variables to HIS implementation framework?	Based on the results of the hypotheses testing, all the moderating variables impacts are not supported (Section 6.2.3, Chapter 6): • Gender → HIS : Not supported • Age → HIS : Not supported • TechExp → HIS : Not supported • ProjRole → HIS : Not supported • JobPosn → HIS : Not supported • EducLevel → HIS : Not supported

This section has re-emphasized the research questions used in this study. By answering the research questions, the current study has provided additional insight to the body of knowledge concerning HIS implementation, particularly in understanding the pertinent factors that influence HIS implementation in Malaysian public hospitals. The overall findings confirm that organizational, technological, socio-technical and project factors must not be ignored at any stage of the HIS implementation. Most importantly, this study has established a framework (research outcomes model) that can assist practitioners and academicians in understanding the HIS implementation process, especially for Malaysian public hospitals.

7.3 Research Contributions

Practitioners and researchers needs must understand the details of HIS implementation to ensure the success of this promising, yet risky and costly endeavor. There have been many studies that have investigated the factors affecting IS implementation; however, arguably, HIS is unique and complex. If it is wrongly implemented, it can cause unwarranted casualties (Ash 2003). The current study has shed some light on the key factors that influence HIS implementation success particularly in Malaysian settings.

Even though the CSFs approach is used in this research study, it does not mean that it is the best or only approach. As mentioned in Chapter 2, CSFs is a method where management can focus on the few key factors that contribute to implementation success; hence, the approach helps to mitigate the search for successful implementation factors. The study has established findings that make valuable contributions to both practitioners and researchers undertaking HIS implementation; in the ensuing section the contributions of the current study are discussed. It is important to highlight that, although the implementation factors do influence the success of HIS implementation, using the results of the findings for policy development must be done with caution; there are still threats to the internal and external validity of this study even though they have been addressed.

7.3.1 Theoretical Contributions

The study has moved the body of knowledge forward by conducting an assessment on the applicability of the CSFs and the D&M success model to measure HIS implementation success. Thus, the theoretical contributions can be described as follows:

i. **Extending CSFs and D&M IS success model.**

   The first contribution is related to the framework (research outcomes model) itself. The study has built a framework that amalgamates two theoretical perspectives; the critical success factors (CSFs) and the D&M success model. By combining these two theories, much benefit was obtained. The critical success factors assisted in filtering the necessary factors that must exist prior an implementation project. Conversely, the D&M success model was used to assess the aftermath of the HIS implementation. By assessing HIS implementation, one could ascertain whether the right determinants were in place. Much research has adopted only one of these approaches, but not both. Thus, the study has shown that both theories could be used to complement each other.

   Additionally, a recent review by Venkatesh, Zhang, and Sykes (2011) points out that much prior research in this area has been largely atheoretical. Using IS theories in the development of the framework has overcome the atheoretical aspects. It can be evidenced from the results of the empirical research that not all of the CSFs were statistically significant. One might be critical that it is a waste of time to keep on experimenting the different CSFs.

However, the drive in the research has been to investigate the required components for a successful implementation. Though the process is inevitable, it success is not!

ii. **A standardized technique for evaluating an implementation model.**

Given the plethora of implementation models that are in existence today, it seems that there is a deficiency of a standardized technique to evaluate them. Much research lacks a theoretical foundation when evaluating the implementation outcome and simply introduces measurements based on common sense, intuition and past practices (Siau and Rossi 2011). Thus, the current study was developed to provide a standardized technique to evaluate the implementation model by incorporating the D&M IS success model. The act of uniting both CSFs and the D&M theory has provided a theoretical foundation to demonstrate the model worthiness.

iii. **New insights on CSFs interrelationships.**

For the third theoretical contribution, this study has provided constructive insights as to the CSFs interrelationships. To date, not much research has examined the relationships between CSFs (Akkermans and van Helden 2002; King and Burgess 2006); it has focused only on the CSFs as independent variables and the outcome as the dependent variable. Investigating the interrelationships between the CSFs was imperative to identify the possibilities of the factors being causally linked such that they reinforce each other. For example, as project management effectiveness increases so does teamwork composition. At times, in order to get the maximum benefit for the implementation, these factors must coincide. By exploring the relationships between the CSFs factors, a better understanding of the implementation process can be achieved.

iv. **Extending the new framework within a healthcare context.**

The health sector is large, indispensable and a growing part of modern economies. This research study has allowed IS researchers to delve into existing theories and models because they do not necessarily fit within the healthcare context. The healthcare and non-healthcare environments have unique and specific differences. It is crucial that IS research in the health sector understand the intricate dynamics of healthcare’s organizational culture. For this study, the specific healthcare in context was tertiary hospitals. Therefore, the study has established a baseline foundation for further research in the health sector.

v. **Developing the conceptual foundations for future empirical research.**

Research has shown that there is a lack of empirical research on HIS implementation, particularly in developing countries. Much study on HIS implementation has focused on developed countries; e.g., for instance UK, USA, Germany and Australia. Conducting this study has helped in explaining the implementation process in developing nations such as Malaysia. Given that the development of the research model has been heavily influenced by the literature from developed countries, the results have shown that some factors are not relevant to the Malaysian context. Again, it has been shown that the study has established a baseline foundation; in this case, for further research in developing nations.

vi. **New insights on HIS implementation in Malaysia.**

The findings have demonstrated that top management, project management, change management, and business planning were not statistically significant determinants of HIS implementation success. This is another contribution this study made to the literature. In fact, the findings suggest that one cannot simply generalize about the CSFs for HIS implementation or any IT implementation. As discussed in Chapter 6, the Malaysian national culture as a high power distance and collectivist society has brought about some impacts on the findings of the study.

vii. **New classifications of CSFs.**

The study not only contributes to the HIS implementation in Malaysia, but also to the body of knowledge in general. The selected CSFs used in this research study were reclassified in order to represent a complete framework.

The reason was to make the research model simple, comprehensible and, yet, comprehensive and to increase the possibility of applying the research model to countries other than Malaysia. As presented in Figure 7.1, the final research outcomes model is still applicable for HIS implementation in Malaysia; four arrows were removed to fit the findings.

viii. A model with substantial explanatory power.

The current study emphasized on enhancing the explanatory power of the research model. Therefore, moderating variables were incorporated to increase the explained variance. Not only does the study unify the CSFs and the D&M model, but the inclusion of the moderating variables makes it a more comprehensive model. Lee, Kozar, and Larsen (2003) caution that there is a tradeoff between a comprehensive and a barebones model. A comprehensive model increases the explanatory power but it also increases the complexity of the model.

ix. Stakeholders' insights.

Finney and Corbett (2007) assert that there is a lack of research on HIS from the perspective of the stakeholders. With regard to HIS implementation in Malaysia, the stakeholders comprise of the sponsors of the project and the users of the system. Thus, the study addressed this scarcity by distributing the survey questionnaire to the users of HIS, board members and management teams. The users of HIS included physicians, nurses, pharmacists, laboratory technologists, vendors, managers and non-management workers. Therefore, the discoveries in the research study were soundly based on the opinions of stakeholders.

7.3.2 Methodological Contributions

Many researchers have been concerned about methodological advances. Contemporary researchers should take the initiative to enhance methodological contributions to the body of knowledge. The following describes the methodological contributions of the current study:

i. **Expanding hospital data.**

There is still a lack of studies that assess hospital data. As discussed in Chapter 1, gaining access to hospital data can be problematic. Hence, the type of data collected for this study is a contribution to the literature. Moreover, many research studies on HIS implementation have managed only to obtain data from less than five hospitals (Aarts, Doorewaard, and Berg 2004; Øvretveit et al. 2007b; Su et al. 2008). In contrast to other HIS implementation research, the current study managed to gather data from six out of the eight public hospitals having THIS implementation in Malaysia.

The fact that the literature on HIS implementation has been dominated by the case studies approach denotes that there is no basis of estimation to determine the extent of success and failure in HIS implementation. Therefore, instead of using the case study approach, a quantitative methodology was used in this study. The findings have indicated that the average explanatory power of all the success dimensions is 80.4% which is a strong indicator of success. Additionally, the data represented 75 percent of THIS implementation. Hence, the outcomes of the current study could become a foundation for future THIS research and implementation in Malaysia.

ii. **Applying the second generation statistical technique.**

Although the use of partial least squares (PLS) analysis is nothing new in IS literature, not many HIS implementation studies have adopted this method. To the best knowledge of the researcher, this research study is among the very few that has applied this approach. Most quantitative HIS implementation studies, particularly in Malaysia, have applied solely first generation statistical techniques for their data analysis; e.g., regression and correlation analysis. Realizing the limitations for the first generation statistical techniques, the PLS approach was adopted in this study. Hence, the study has contributed to the development of HIS implementation studies and methodologies in Malaysian settings.

7.3.3 Practical Contributions

The outcomes of the study were presented in Chapter 5 and discussed in Chapter 6. The empirical findings in the study have provided an important practical contribution to public hospitals' practices in Malaysia. Furthermore, the refined and final research model, presented in Figure 7.1, has provided detailed information on factors that contribute to HIS implementation success. The following list deliberates on the practical contributions from the study:

i. **A model or framework for the hospital managements.**

The CSFs serve as a guide for future HIS implementation processes in Malaysian public hospitals. The results in the study show that hospital managements are now concerned about possible factors that are vital for HIS implementation success. With this knowledge, they can improve early planning, anticipate future problems and take corrective action during the stages of implementation. Hence, CSFs can be used as a planning tool where the management can focus on key areas and minimize the risk of failure.

ii. **Linking the research model [framework] to the actual outcome of the research.**

The results of the current study highlight the issue that factors are interrelated. If factors are implemented together much benefit can be acquired. For example, the success of a change management and culture program may not be possible without the support of top management and project management. Also, developing a positive organizational culture may not be possible without direction from top management. The discovery of specific interrelationships between the CSFs has helped determine the required factors during HIS implementation. Hence, the model outcomes serve as a handbook for proactive decision-making.

iii. **Combining Generation Y influences in future implementation.**

The results from the study have shown that there are possibilities that the non-significant findings were brought about by the impact of Gen Y employees. As discussed in Chapters 2 and 6, Gen Y is fast entering the workforce. This generation has a different set of ideology and can reform future HIS implementation (Piper 2012; VanMeter et al. 2012). Hence, it is imperative that future HIS implementation planning should address the influence of Gen Y; e.g., future HIS implementation should include more wireless network or infrastructure so that these employees can access the HIS from anywhere, anytime. Yee, Mills, and Airey (2008) emphasize that to create a sustainable healthcare future, understanding Gen Y is compulsory. At present, given the majority of Gen Y entering the health workforce, their influence must not be taken lightly.

iv. Associating the national culture impacts to HIS implementation.

There is also a possibility that some non-significant findings were caused by the high power distance in Malaysia. Future HIS implementation must take into account the impact of national culture. The management needs to develop a positive organizational culture and promote a paradigm shift among the members of the health organization if they are to advance HIS implementation. For example, the management should support open communication among all employees in the organization. If the power distance is too high, it can become a hindrance to the freedom of speech; thus, future expansion of an organization might not be feasible where employees are hesitant to voice their opinions about the system or any other matters.

v. Isolating external expertise as a separate factor.

Although external expert, consultant and vendor support have been combined in the team composition success factor, it seems that the factor has to be emphasized on its own due to the over-dependence of the employees with the vendors. As explained in Chapter 6, HIS intricacy makes employees overly reliant on vendor support because they do not want to be blamed if anything goes wrong. Therefore, the management must monitor external experts closely so that the vendors can provide knowledge transfer and full support to existing employees.

vi. **A model or framework that is context independent.**

Although the model was meant for hospital specific contexts, it can also be applied to non-hospital settings. The term ‘non-hospital’ may refer to other health information systems besides HIS. For example, besides hospitals, the model can be applied to other healthcare settings such as clinics or general practices. Also, there is a possibility that the model can be applied to non-healthcare settings because the research model was derived from common IS concepts. However, exploring this notion is beyond the scope of the current research study.

7.4 Implications for Hospitals’ Managements

The outcomes of the current study have formed useful implications for research, particularly in the healthcare sector. The important inferences from the findings can be used as a reference for hospitals planning to implement HIS or currently implementing HIS. Furthermore, the improved research model represents real-world circumstances. Therefore, hospitals embracing HIS should use the model as a reference point in order to gain the maximum benefit from the implementation. Moreover, those that have implemented HIS can still use the model to perform corrective actions for the purpose of enhancing their existing implementation processes. Below are some important managerial implications of the research study:

i. **Implications from non-significant findings.**

Although some factors (i.e., business plan, top management, project management and change management) were found to be insignificant for HIS implementation success, the factors are still essential in the overall implementation. This point can be justified from the interrelationship analyses where all factors were found to reinforce one another. Results from the indirect effect analyses also revealed that some factors were found to be statistically significant indirectly. Therefore, the management must not neglect any of these factors during implementation.

ii. Building the 'right' culture.

Findings in the current study indicated that culture can be the cause of non-significant influences. It is important to understand that Malaysians in general, and government servants in particular, abide with the decisions of the management. Thus, it is in the hands of the hospital management to cultivate the 'right' culture in the organization. Culture is also known to have a significant influence on user acceptance (Bandyopadhyay and Fraccastoro 2007).

In order to nurture the 'right' culture, top leaders must lead the effort by fostering a culture that supports open communication; this can be achieved by having a weekly or bi-monthly meeting for opinion exchanges. Management must show employees that their voices are heard and acted on, and recognize employees for their contributions. In view of the fact that the main objective of the research was to refine HIS implementation, the hospital management must take the initiative to ensure that users do adopt the system by promoting the benefits of HIS and emphasizing how HIS can assist their daily activities. Also, hospital management must promote a two-way communication so that users can express their worries, uncertainties and/or frustrations about the existing HIS implementation.

Furthermore, the management should nurture the culture of knowledge sharing among employees, and with vendors and consultants. The current situation has shown that knowledge sharing is not prevalent; rather, users seem to be dependent on vendors especially when the system has to be customized. Development of a positive culture is not easily accomplished since vendors and consultants have their own motives for not being willing to share their knowledge. One way to enforce knowledge transfer is by imposing on vendors and consultants a written agreement before project commencement.

iii. **Embedding IT governance into the business processes.**

Nowadays, many organizations promote IT governance to achieve better alignment between business and IT (De Haes and Van Grembergen 2009). IT governance is a concept used to better manage IT priorities, processes and people. It ensures that IT activities are aligned with the business needs and, most importantly, tries to promote IT sustainability. Given that IT investments in hospitals are expensive, it would be wise to consider the basis for IT governance.

iv. **HIS implementation is essential for ICT advancements.**

In the health sector, ICT expansions can be used to promote better health, improve decision-making and improve effectiveness of the health institutions. ICT in the hospital sector is made up of the communication network, intranet, public network (internet), hospital information systems (HIS), laboratory information systems (LIS), pharmacy information systems (PIS), radiology information systems (RIS) and so forth. Given the benefits of ICT, having HIS is a precondition for hospital development. The management should not have second thought about HIS implementation. Furthermore, the findings of the current study have assisted in increasing the chances of a successful HIS implementation.

v. **HIS characteristics matters to end users.**

As highlighted previously, employing HIS is essential in order to gain competitive advantage. The features or the characteristics of the selected HIS are twice as important as implementing the HIS itself. If the implemented HIS cannot deliver the required functionalities, this is considered as an implementation failure, because most likely users would not want to use such an unacceptable system. Therefore, not only must the management ensure that the chosen system has all the necessary business functions, but they also need to ascertain that a reliable team is constructed to select the most appropriate system.

7.5 Limitations

Despite its substantial contributions and implications, the study is not without its constraints. The first one relates to the CSFs. The current study focused on seven CSFs as the possible cause of HIS implementation success. Although the CSFs have been reclassified to cover as many success factors as possible, there are still possibilities of the existence of other success factors. Nevertheless, the CSFs used in this study are among the top 20 success factors that have been highlighted in many CSFs literature (Al-Mashari, Al-Mudimigh, and Zairi 2003; Dezdar and Sulaiman 2009; Nah, Lau, and Kuang 2001; Somers and Nelson 2004). Other constraints in the study are described below:

i. Survey methodology.

The first limitation found in the survey methodology was the self-reporting questionnaire, which is known to be less reliable since there is no evidence whether the respondents are revealing the entire truth or otherwise especially when the information sought is complex or awkward. There are possibilities that they responded according to social influences [subjective norms]. Bandyopadhyay and Fraccastoro (2007, 522) describe social influence as "societal pressure on users to engage in a certain behavior". Thus, the respondents may tend to have answered in a favorable manner. This occurrence is also known as the social desirability bias.

The second limitation pertains to the common method bias. Basically, two types of respondents are desired to answer the questionnaire, where one group measures the implementation factors [exogenous constructs] and the other assesses the HIS implementation success [endogenous construct]. The theory states that if one person provides the information for both the independent and dependent constructs, this could cause bias in the study. Due to time, budget and resources constraints, having two groups of respondents are not viable for this study. Nonetheless, the researcher made an effort to minimize this bias which is described in Section 5.2.3 of Chapter 5. One defense is that of Doty and Glick (1998) who argued that most detected bias is inadequate to invalidate the findings of research.

ii. Generalizability.

The findings in the study cannot be generalized beyond the sample of the people, organizations and settings due to several impeding factors: 1) culture differences, 2) biases in the study, 3) the influence of Gen Y, and 4) sample size. Firstly, the current study was conducted in Malaysia; therefore, it is not feasible to generalize the findings to other populations especially those that have a different national culture. Nonetheless, the findings can still be used as a guide for other researchers, especially when applying them to countries that have a similar national culture with high power distance and a collectivist society as in Malaysia.

Even though potential biases in the study have been addressed, the fact that bias still exists may be another hindrance to generalizability. Also, in respect to Gen Y, many studies have shown that they are knowledgeable with technology (Mills, Airey, and Yee 2007; Yee, Mills, and Airey 2008). This supposition has to be cautioned since there are studies that suggest the Afro American and Latinos are much behind whites in terms of technology (Berk 2009). As a result, studies with Gen Y influences cannot be generalized simply.

Another explanation as to why generalization is usually unattainable is the sample size. Hair et al. (2010, 175) recommended that the desired sample size should be "15 to 20 observations for each independent variable". In addition, the sample must be representative for the results of the study to be generalized. Therefore, both size and representativeness of data must be taken into consideration prior to generalization. Although the study meets the minimum sample size requirement for PLS analysis, the number of samples is insufficient to allow for generalization.

Another generalizability limitation are the inconsistent relationships among constructs if the study were to be replicated elsewhere. Sun and Zhang (2006) propose that the limited explanatory power and inconsistencies between studies can be improved by incorporating moderating variables. Although the study included moderating variables in its model, the results imply that the moderating variables are not statistically significant in relation to HIS implementation success.

Regardless of all these constraints, the study has provided some insightful knowledge on HIS implementation. The limitations call for an improvement and refinement of the existing study and it is of utmost importance to search for opportunities to further understand the HIS implementation process.

7.6 Recommendations for Future Research

This study was designed to investigate the organizational, technological, socio-technical and project factors that could influence HIS implementation success. The findings, limitations and implications of the current study have resulted in a number of avenues for future research being recognized.

i. IS implementation phases.

It needs to be emphasized that system implementation involves several phases. Among the frequently quoted implementation phases in the literature are (Mandal and Gunasekaran 2003; Prijatelj 1999; Stoop and Berg 2003):

- Pre-Implementation (Planning and Testing Phase)
- Implementation (‘Go-Live’ Phase)
- Post-Implementation (Maintenance and Continuous Improvement Phase)

Due to time, resource and financial constraints, the implementation framework of the research outcomes model does not take into account the phases of implementation; nor were the factors at the different phases of implementation prioritized. Thus, further works need to be undertaken to ascertain at which phase of the implementation specific factors are more critical than others.

Testing the success factors at each phase of the implementation add insight as to how the implementers should best plan the entire implementation project. For example, if change management is one of the determinants of a successful HIS implementation, then at which implementation phase should change management be introduced? Consequently, must the change management program be continued until the post implementation phase or otherwise? It was forecast that the pre-implementation phase is significant for planning purposes, and the post-implementation phase was noteworthy for maintaining a sustainable HIS. Thus, it is highly recommended for future work to have a before- and after-implementation survey to capture the complete scenario of the implementation process. This could be achieved by conducting a longitudinal study instead of a cross-sectional approach as was employed in this study.

ii. Refining the research model.

Given the final research outcomes model that was able to explain up to 64.5% of the variance in HIS implementation, further studies can be carried out to improve this model by incorporating additional success factors such as physician involvement and government influence. Studies by Sengstack (2004) and Creswick and Callen (2002) have indicated that without physician support, most HIS implementation is likely to fail. This is because physicians are the dominant users of HIS and they need to be involved from the beginning of the implementation process.

To further explain the extent of HIS implementation, the model can be enhanced by incorporating other theoretical constructs; e.g., task-technology fit (Goodhue and Thompson 1995), fit-viability (Liang et al. 2007), dynamic capabilities (Barney 1991), socio-technical theory (Bostrom and Heinen

1977) and contingency theory (Weill and Margrethe 1989). The options are open for future researchers to explore ways of making the model either more specific or more universal. It would be novel if the various combinations of CSFs impact on HIS implementation can also be supported by theoretical explanations. Table 7.2 provides a list of theories that can be used to refine the research model.

Table 7.2: Theoretical Constructs to be Considered

Theory	Main Idea
Task-technology fit	Fit between IT and business processes
Fit-viability	Fit feasibility between IT and business processes to attain sustainable competitive advantage
Dynamic capabilities	Continuous improvement to assure sustained competitive advantage
Socio-technical	Fit between the technical and social subsystem which formed the organization
Contingency theory	Fit between the organizational subsystems and business environment

Furthermore, the non-significant impact of several success factors and moderating variables found in the study are worth further investigation. There are possibilities that the outcomes can be different if the sample size is increased. Additionally, the study emphasis was on the explanatory power of the research model and many factors could be introduced to increase its explanatory power. Future research may strive to develop a parsimonious research model so that it can be applied in other countries or to other research domains besides the health industry.

iii. Research methodology.

As discussed previously, the survey methodology does have disadvantages, so future research could adopt the case study approach to further understand the complexities of the HIS implementation process and how the hospitals manage it. The case study approach is acknowledged as appropriate for studying complex social phenomena (Yin 2003).

Other researchers have favored the multi-method or mixed method approach because a single research approach for studying information systems phenomena may be somewhat rigid (Doty and Glick 1998; Spector 2006). Collectively, the quantitative and qualitative approaches complement each other to provide a clearer picture (Orlikowski and Baroudi 1991; van der Meijden et al. 2003). Further, the plurality of methodological approaches is essential in assessing the implementation process in order to broaden the understanding and use of informatics applications (Kaplan 2001). Moreover, the advantages of mixed method have been discussed in extant literature and are no longer negligible (Gable 1994; Kaplan and Duchon 1988). Given that several CSFs in this study were found to be statistically non-significant, the CSFs can be explored further by using a qualitative approach to gain a deeper understanding of them.

The tasks needed to improve HIS implementation should not fall solely on the implementers and technical personnel. Clinicians and physicians too should be involved since it is imperative that those who are implementing HIS should cooperate and comprehend all views, particularly the opinions of the primary users of the system. Thus, a multi-perspective evaluation method could be used to improve the implementation process (Ash et al. 2000). Other than employing a different research approach such as the multi-method or multi-perspective method, future researchers are encouraged to consider a longitudinal study in order to gain valuable insights to HIS implementation.

iv. Data analysis.

As pointed in Section 3.2.4 of Chapter 3, HIS success is represented as a reflective second order construct. Justifications have been made in Section 5.4.1.2 for favoring the second order reflective construct. Future research should investigate whether HIS success is actually a formative or reflective second order construct. This is because many researchers tend to specify constructs erroneously as reflective where, upon close inspection, they should be formative. The problem with misspecification of constructs is that it increases the possibility of type I or type II errors (Gable, Sedera, and Taizan 2008; Petter, Straub, and Rai 2007).

Instead of using PLS analysis, future researchers may want to adopt the Rasch model analysis. The Rasch model is an approach used for assessing the attitudes of the respondents from their responses on the questionnaire. It is robust against missing data and, most importantly, it supports predictive validity and construct validity. In other words, the model is likely to capture, by analyzing their response pattern, whether the respondents were truthful or not when answering the questionnaire.

v. **Race as a moderating variable.**

Malaysia is a multiracial and multicultural country. It would be beneficial if race could be tested as one of the moderating variables. This will allow researchers to explore each race inclination on which CSFs are pertinent to influence HIS success.

Finally, there should be more studies on HIS implementation to assess the differences and similarities among Malaysian public hospitals as well as hospitals in other developed and developing countries.

7.7 Summary

As the need to provide world-class healthcare services and to attain the Vision 2020 goals intensifies, it is of paramount importance that Malaysia advances its healthcare industry by means of ICT. Hence, this study has been used to explore and investigate the necessary factors that can ensure successful HIS implementation.

The final chapter began with a review of the research questions to ensure that the research question had been addressed appropriately. This was followed by comments on the contributions of the study and the implications to the health industry in Malaysia. The contributions of the research can be classified in terms of theory, methodology and practice. In terms of theoretical contributions, the study is one of the initial studies on HIS implementation in Malaysia. Also, it has offered a practical model for future HIS implementation. More specifically, the research outcomes model has extended prior theories and research relating to IS implementation.

With regard to methodological contribution, the current researchers collected data from Malaysian public hospitals having THIS implementation; the type of data is rare considering the complex procedures involved. In terms of a practical contribution, the model provides guidelines for managers in decision-making and planning future HIS implementation. Most notably, the study highlighted potential reasons for the statistical non-significance of some factors (viz., top management, project management, business plan and change management) and offered suggestions on how future research could further advance the discipline.

Finally, limitations of the research study were acknowledged and avenues for future research determined. Overall, the study has provided worthwhile, valuable and original insight into the HIS implementation process in Malaysian public tertiary hospitals. It has determined that if all seven factors are taken into consideration it can explain up to 65.6% of variance in HIS implementation, but if only three significant factors are considered 64.5% of the variance is still explained. Both values are indicative of substantial explanatory power in explaining HIS implementation. Most importantly, understanding and enhancing of the newly established knowledge will assist greatly in increasing the success rate for future HIS implementation processes.

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Appendices

Appendix A

Glossary and Malaysian Infrastructure

A.1 HIS Glossary

The following glossary is deemed useful for the current study. These terms are often found in HIS literature thus a brief description of the terms is provided.

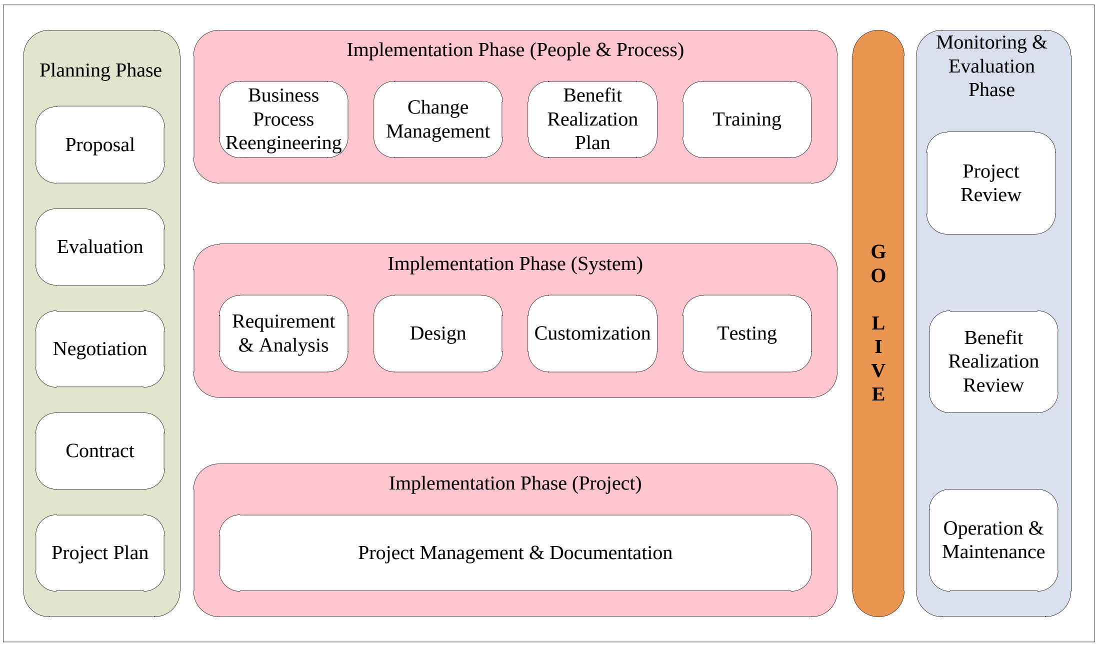
Table A.1: Healthcare Glossary

Terms	Description	References
Consumer Health Informatics	"Consumer health informatics is the branch of medical informatics that analyses consumers' needs for information; studies and implements methods of making information accessible to consumers; and models and integrates consumers' preferences into medical information systems".	Eysenbach (2000)
Digital Imaging and Communications in Medicine (DICOM)	" a communication standard to exchange text and images, developed by ACR/NEMA" ACR – American College of Radiology, the professional society for radiologists in the US. NEMA – National Electrical Manufacturers Association.	van Bemmel and Musen (1997, 568)
Electronic Health Record (EHR)	"… a more robust version of the EMR. Its advanced functionality allows the EHR system to link to other sources of information, combining data from and interoperate with several different computer applications and databases (e.g., laboratory, radiology, public health registries, prescription order entry systems, etc.)".	University of Alabama at Birmingham (2005)
Electronic Medical Record (EMR)	"an electronic patient record that resides in a system specifically designed to support users by providing accessibility to complete and accurate data, alerts, reminders, clinical decision-support systems, links to library of medical terms, and other aids".	Classen (1994)
Electronic Patient Record (EPR) or Computer-based Patient Record (CPR)	"electronically stored information about an individual's lifetime health status and health care"	Dick, Steen, and Detmer (1997)
Health Informatics	"The knowledge, skills and tools which enable information to be collected, managed, used and shared, to support the delivery of healthcare and to promote health".	Madden (2010)
Health IT (HIT)	"It is the term used to describe the application of computers and technology in health care settings"	Hersh (2009)

Terms	Description	References
Health Level 7 (HL7)	"… is a standard for medical informatics exchange between healthcare providers". "Its applicable area includes order entry of many kinds, test result reporting, prescriptions, Admit/Discharge/Transfer of patient, etc."	Kimura (1999)
Logical Observation Identifiers Names and Codes (LOINC)	"this database contains codes, names, and synonyms for more than 6,300 clinical chemistry test observations. It has been made available on the Internet"	van Bemmel and Musen (1997, 582)
Medical Informatics	"Medical Informatics comprises the theoretical and practical aspects of information processing and communication, based on knowledge and experience derived from processes in medicine and health care"	van Bemmel and Musen (1997, 583)
National Health Service (NHS)	"governmental health organization of the United Kingdom"	van Bemmel and Musen (1997, 585)
Personal Health Record (PHR)	"An electronic application through which individuals can access, manage and share their health information, and that of others for whom they are authorized, in a private, secure, and confidential environment.''	Tang et al. (2006, 122)
Public Health Informatics	"as the systematic application of information and computer science and technology to public health practice, research, and learning"	Yasnoff et al. (2000, 68)

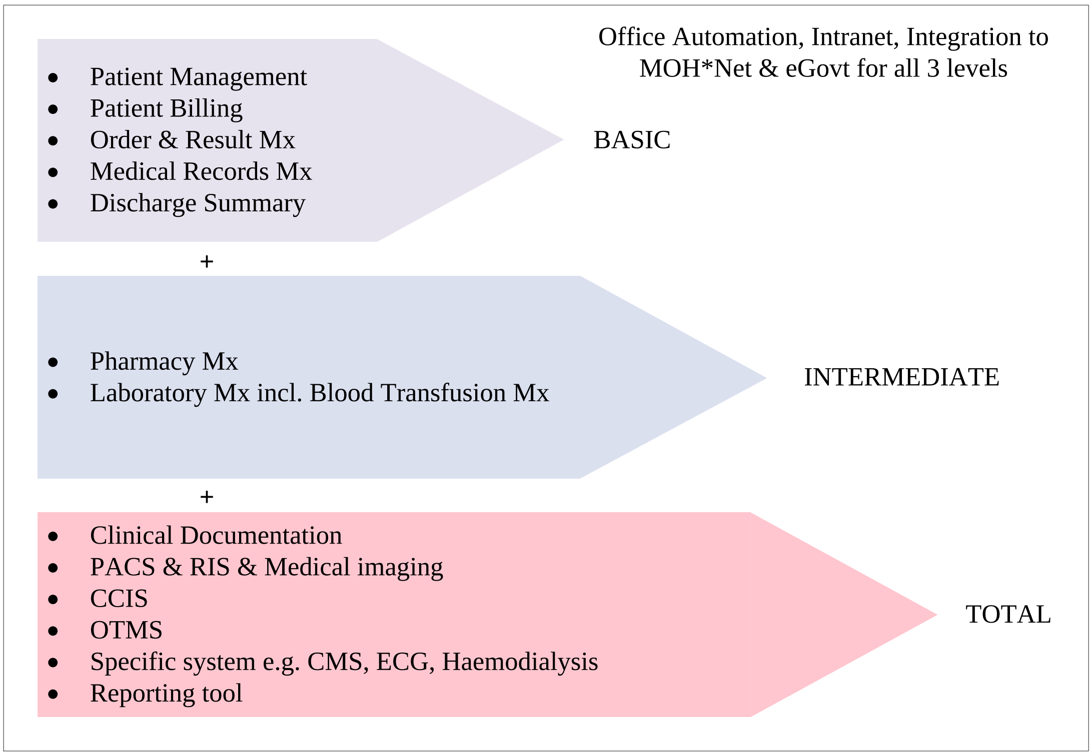
A.2 Malaysia HIS Infrastructure

Figure A.1: HIS Implementation Methodology



Source: Adapted from Planning and Development Division, MOH Malaysia (Ministry of Health Malaysia 2010a).

Figure A.2: HIS Levels in MOH Hospitals



Source: Adapted from Planning and Development Division, MOH Malaysia (Ministry of Health Malaysia 2010a).

A.3 Candidate Critical Success Factors

Table A.2: Cross Reference Literature Review of Candidate CSFs.

Study	Area / Domain	Country	Candidate Critical Success Factors									
			BP	SS	CM			TC	PM	TM		EC
					Culture	User Involvement & Participation	User Educ. & Training			Leader-ship	Champion-ship	
Prijatelj (1999)	HIS	Slovenia	√			√		√		√		
Lorenzi and Riley (2000)	HIS	USA			√		√			√		√
Nykänen and Karimaa (2006)	HIS	Finland				√						
Ludwick and Doucette (2009)	CPOE, EMR, EHR, CDSS, PACS, NIS, PHR	Canada, US, Denmark, Sweden, Australia, New Zealand, United Kingdom					√	√	√	√		
Ash, Gorman, et al. (2003)	CPOE	USA			√		√					
Bingi, Sharma, and Godla (1999)	ES	USA					√	√	√	√		
Sumner (1999)	ES	USA					√	√		√		

Study	Area / Domain	Country	Candidate Critical Success Factors									
			BP	**SS**	**CM**			**TC**	**PM**	**TM**		**EC**
					Culture	User Involvement & Participation	User Educ. & Training			Leader-ship	Champion-ship	
Holland and Light (1999)	ES	UK				√		√	√	√		√
Stefanou (1999)	ES	USA					√	√		√	√	√
Grover et al. (1995)	BPR	USA					√		√			
Clemons, Thatcher, and Row (1995)	BPR	USA				√			√	√		
Evans (1994)	BPR	Europe				√						√
Larsen and Myers (1997)	BPR	NZ						√		√		√
Murphy and Staples (2007)	BPR	Australia							√	√		√
Hammer and Champy (2003)	BPR	USA						√	√			√
Burkhard (1990)	CASE	USA				√	√		√	√		√
McClure (1979)	Software Engineering	USA						√		√		
Brash (1999)	Enterprise Modeling	USA				√						
Rosemann (1998)	Process Modeling - Quality	Australia				√			√			√
Moody and	Data Modeling -	Australia				√			√			√

Study	Area / Domain	Country	Candidate Critical Success Factors									
			BP	**SS**	**CM**			**TC**	**PM**	**TM**		**EC**
					Culture	User Involvement & Participation	User Educ. & Training			Leader-ship	Champion-ship	
Shanks (1994)	Quality											
Moody (1996)	Data Modeling	-				√						√
Lindland, Sindre, and Solvberg (1994)	Conceptual Modeling - Quality	Norway				√				√		√
DeLone and McLean (1992)	IS	USA				√						
Bailey and Pearson (1983)	IS	USA				√						
Ginzberg (1981)	IS	USA				√						
Ives and Olson (1984)	IS	USA				√						
Lucas (1981)	IS	USA				√						
Fisher (2007)	IS	Australia				√						
Davis (1989)	IS	USA				√						
Warne and Hart (1996)	IS	Australia								√		
Srivihok (1999)	IS – EIS	Australia				√	√					√
Rainer Jr and Watson (1995)	IS – EIS	USA				√						√
Chuang and Shaw (2000)	ES and IS	USA						√	√	√		

Source: Adapted from Sedera, Rosemann, and Gable (2001).
Note: Studies are sorted by area/domain.

Appendix B

HIS Implementation in Developed Countries

Table B.1: Literature on HIS Implementation in Developed Countries

Study	Description	Methodology	Findings	Country
Kukafka et al. (2003)	Address the gap between health IT implementation and the integration of theories. Identify factors that hinder usage behavior. Provide insights to high failure rates.	Systematic literature analysis – search multiple databases with specific search terms.	Suggest the need to understand the roles of human and organization factors to further prosper.	USA
Green et al. (2006)	Identify CSFs for translating knowledge of chronic care management into practice. To increase physicians IT usage.	Case study on 30 physicians and 1 project management team.	ICT is one of the main CSF for success. However, success can be advanced by adding other CSFs such as organizational partnership, project management and funding. To enhance usage technology factors needs to be combined with interrelated systems.	Canada
Callen, Braithwaite, and Westbrook (2008)	Develop a multiple perspective model called Contextual Implementation Model (CIM).	Qualitative approach. Interviewed 28 health professionals and observed 55 physicians.	CIM facilitates the implementation of CIS and can be used as a guide for future implementations. Improve physicians CIS usage.	Australia
Sorensen et al. (2011)	Factors affecting implementation of targeted injury detection systems (TIDS).	Case-study methodology. Interviewed 23 individuals who are implementation champions and users at five hospitals.	Easier to implement low-complexity innovations. Therefore, must give: • high priority to innovation implementation • allocate sufficient resources • effective communication • align innovations with workflows and IS • should monitor changes in organizational priorities • availability of implementation staff • external regulations and constraints that may pose	USA

			barriers Limitations: • factors such as culture, change readiness, quality and capacity improvement were not examine	
Yao, Chu, and Li (2011)	Implementation of RFID technologies in healthcare: • provides efficient and accurate access to medical data to health professionals • tracking capability to locate equipment supplies and people in real time	Literature review divided into 3 phases: • Phase 1: Literature identification and collection • Phase 2: Literature categorization • Phase 3: Literature analysis	Major obstacles to adopt RFID are technological limitations, costs, interference, lack of global RFID standards and privacy concerns. Suggest having more studies that can increase acceptance of RFID in healthcare such as ways to lower the implementation costs and address privacy issues.	USA
Mei et al. (2011)	Promoting health IT in long term residential care facilities (LTRCF).	Develop a system that can promote health IT.	The system was successfully implemented. User training is important to enhance system usage. The study suggests that human factors must be considered to ensure stakeholders' expectations are met.	USA
Rozenblum et al. (2011)	Identify ways to improve the adoption of EHR.	Case study. Interviewed 29 stakeholders. Use grounded theory to identify themes and relationships	Clinicians must be involved and an e-health policy must be established to enhance adoption of the EHR system.	Canada
Lau, Price, and Keshavjee (2011)	Propose a Clinical Adoption Framework for evaluating HIS adoption in order to understand HIS success in Canada.	Use surveys to test the Clinical Adoption Framework.	HIS adoption will increase if the quality of the HIS such as system, information and service quality is good.	Canada

Appendix C

HIS/IS Implementation in Developing Countries

Table C.1: Literature on HIS/IS Implementation in Developing Countries

Study	Description	Methodology	Findings	Country
Heeks (2002)	Develop a model to explain the high rates of IS implementation failures in developing countries.	Multiple case studies in several countries.	Model and theory help to understand IS implementation cases in developing countries.	India, Thailand, South Africa, Ghana, China
Krishna and Walsham (2005)	Analyze the context and processes involved for IS success.	Longitudinal case study. 29 interviews (1999-2003).	Successful IS implementation in developing countries must address both technical and social issues. Implementers must consider specific context such as organization, sector and region.	India
Clifford et al. (2008)	Investigate the barriers of IT in healthcare for developing countries.	Systematic literature analysis.	Findings revealed that developing countries are lacking on IT health practices, infrastructure and resources such as medicines. Successful implementation may require multi-factorial approach.	Peru, Haiti
Malik and Khan (2009)	Provide a better understanding of HIS implementation in developing country.	Qualitative case study approach in Pakistan Institute of Medical Sciences (Aug – Sep 2007).	Successful HIS implementation involves detailed planning and the system must be practical to be used. Senior management involvement is not mandatory but strong users' network is required for the success of HIS implementation.	Pakistan
Benson (2011)	Examine empirically the factors that prevent HIS successful adoption.	Literature review.	The Nigerian government must provide better IT infrastructure to encourage HIS adoption.	Nigeria
Isabalija et al. (2011)	Investigate telemedicine adoption, implementation and sustainability in Uganda	Both qualitative (case studies on two hospitals) and quantitative methods were used to collect and analyze data.	Main hindrances for telemedicine adoption were caused by lack of telemedicine policy, knowledge, skills and resistance to change by hospitals employees.	Uganda
Cline and Luiz (2011)	Examines the impact of HIS implementation on user adoption, organizational culture and service delivery.	Mixed methods (surveys and interviews) on three groups of users (e.g., hospital administrators, nurses, doctors)	Provide insights on IT implementation	South Africa

Appendix D

Survey Invitation Letter

Date

MOH Research Ethics Committee (MREC) /
NIH Secretariat
Ministry of Health Malaysia,
c/o Institute for Health Management,
Jalan Rumah Sakit, Bangsar,
50900 Kuala Lumpur, Malaysia.

Dear Sir/Madam

Application to Conduct a Survey in Ministry of Health Malaysia

My name is Zainatul Shima Abdullah; I am a PhD student at Curtin University of Technology. I am conducting a research in the field of Information Systems Management under the school of Information Systems (Curtin Business School).

The aim of the research is to identify the factors that influence a successful IT system implementation used in hospitals. The information gathered in this research will be of significant importance to academics as well as the hospitals administration that are considering any IT system implementation.

Your assistance in this research is greatly appreciated and is crucial towards the success of its findings. This questionnaire only takes a maximum of 20 minutes to complete. If you feel uncomfortable in answering certain questions, please feel free to disregard them. The survey should be completed by the Hospital's Decision Makers or Top Management, IT Personnel, end-users or key-users, and vendors that are involved in implementing an IT system.

All received surveys will be held as strictly confidential, and there will be no material published to identify you or your organization. Please refer to the information sheet attached for further details.

If you have any enquiries, do not hesitate to contact myself by email at zainatul.abdullah@postgrad.curtin.edu.au or by phone on +614 1080 6298. Alternatively, feel free to contact my supervisor, Vanessa Chang by email at vanessa.chang@cbs.curtin.edu.au.

Thank you in advance. You have contributed greatly to the field of IS research.

Yours faithfully,

Zainatul Shima Abdullah
PhD Doctoral Student
Curtin University of Technology
Perth, Australia
Email: zainatul.abdullah@postgrad.curtin.edu.au
Mobile: +614 1080 6298

Associate Professor Vanessa Chang
PhD Supervisor
Curtin University of Technology
Perth, Australia
Email: vanessa.chang@cbs.curtin.edu.au

Appendix E

Participant Information Sheet

My name is Zainatul Shima Abdullah and I am currently conducting a research on ‘Hospital Information System Implementation Framework: Critical Success Factors for Malaysian Hospitals’. This research forms part of the requirements for fulfillment of my Doctoral Degree.

Purpose of this Research

This research intends to study the critical success factors for IT system implementation in Malaysian hospitals. The major objective of this research is to identify factors that influence the successful implementation of the IT system. The research will also develop a conceptual framework based on theory and practice of IT system in Malaysian hospitals. This framework will assist in the successful implementation of IT system.

Your Role

- The survey will be related to the specific role:
- Hospital’s decision makers or Top Management
- IT Personnel that are involved in implementing an IT system
- End-users or key-users who are involved in implementing an IT system
- Vendors who are involved in implementing an IT system

Survey Length

The survey process will take approximately 20 minutes.

Consent to Participate

Your involvement in the research is entirely voluntary. You have the right to withdraw at any stage without affecting your rights or my responsibilities. When you have signed the consent form I will assume that you have agreed to participate and allow me to use your data in this research.

Confidentiality

The information you provide will be kept separate from your personal details, and I will only have access to this besides my supervisor. The survey information will not have your name or any other identifying information, and in adherence to university policy, the survey information will be kept in a locked cabinet for five years, before it is destroyed.

Rights of Research Participants

Your completion and return of the enclosed **Consent Form** indicate your agreement to participate in this study.

You may withdraw your consent at any time and discontinue participation without penalty or consequence. You are not waiving any legal claims, rights or remedies because of your participation in this research. Should you require any additional information relating to the survey, please do not hesitate to contact the researchers using the following email address:

zainatul.abdullah@postgrad.curtin.edu.au
Supervisor: Vanessa.Chang@cbs.curtin.edu.au

This questionnaire has been approved by the Curtin University Human Research Ethics Committee (Approval No: IS-10-09). Should you wish to lodge a complaint about any matter relating to this survey, please contact:

Secretary
Human Research Ethics Committee
Office of Research and Development
P.O. Box U1987
Perth WA 6845
hrec@curtin.edu.au

**THANK YOU VERY MUCH FOR YOUR INVOLVEMENT IN THIS RESEARCH.
YOUR PARTICIPATION IS GREATLY APPRECIATED.**

Appendix F

Consent Form

I have read the information sheet and understand the purposes of the study and have been given the opportunity to ask any related questions. I understand that I may withdraw from the study at any time.

I understand that all information provided by me is strictly confidential. Any published material will not include participant's name or other identifying information. I understand that written records will be kept for a period of 5 years in a locked cabinet at Curtin University of Technology, Perth, WA, Australia.

On the basis of the above, I agree to participate in this study.

Name : ………………………………………….

Signature : ………………………………………….

Date : ………………………………………….

Appendix G

Curtin Ethics Approval

MINUTE

Curtin
UNIVERSITY OF TECHNOLOGY

To	Zainatul Shima Abdullah
From	Francesca Vallini
Subject	Protocol Approval IS_10_09
Date	27 July 2010
Copy	Vanessa Chang

School of Information Systems

Human Research Ethics Committee

TELEPHONE 9266 7027
FACSIMILE 9266 7348
EMAIL
Francesca.Vallini@curtin.edu.au

Dear Shima

Thank you for your "Form C Application for Approval of Research with Minimal Risk (Ethical Requirements)" for the project titled **'Business Process Management System Implementation Framework: Critical Success Factors for the Malaysian Hospitals'.** On behalf of the Human Research Ethics Committee I am authorised to inform you that the project is approved.

The approval number for your project is **IS_10_09**. *Please quote this number in any future correspondence.* Approval of this project is for a period of twelve months from **27.07.2010** to **27.07.2011.**

If at any time during the allotted period changes/amendments occur, or if a serious or unexpected adverse event occurs, please advise me immediately by completing the Form B.

Please find attached copy of your application duly authorised by the reviewer together with Form B.

F. Vallini

Francesca Vallini
Coordinator for Human Research Ethics
School of Information Systems

This study has been approved by the Curtin University Human Research Ethics Committee. If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784.

Appendix H

MOH Ethics Approval

PEJABAT TIMBALAN KETUA PENGARAH KESIHATAN
OFFICE OF THE DEPUTY DIRECTOR-GENERAL OF HEALTH
(PENYELIDIKAN & SOKONGAN TEKNIKAL)
(RESEARCH & TECHNICAL SUPPORT)
KEMENTERIAN KESIHATAN MALAYSIA
MINISTRY OF HEALTH MALAYSIA
Aras 12, Blok E7, Parsel E, Presint 1
Level 12, Block E7, Parcel E, Precinct 1
Pusat Pentadbiran Kerajaan Persekutuan
Federal Government Administrative Centre
62590 PUTRAJAYA

Tel : 03 88832543
Faks : 03 88895184

JAWATANKUASA ETIKA & PENYELIDIKAN PERUBATAN
KEMENTERIAN KESIHATAN MALAYSIA
d/a Institut Pengurusan Kesihatan
Jalan Rumah Sakit, Bangsar
59000 Kuala Lumpur

Ruj. Kami : (2) dlm.KKM/NIHSEC/08/0804/P10-491
Tarikh : 2 November 2010

Puan Zainatul Shima Abdullah
Faculty of ICT
International Islamic University Malaysia

Puan,

NMRR-10-848-6860
Business Process Management System Implementation Framework: Critical Success Factors for the Malaysian Hospitals

Lokasi Projek : **Hospital Serdang / Hospital Selayang / Hospital Putrajaya / Hospital Ampang / Hospital Sungai Buloh**

Dengan hormatnya perkara di atas adalah dirujuk.

2. Jawatankuasa Etika & Penyelidikan Perubatan (JEPP), Kementerian Kesihatan Malaysia (KKM) tiada halangan, dari segi etika, ke atas pelaksanaan kajian tersebut. JEPP mengambil maklum bahawa kajian tersebut tidak mempunyai intervensi klinikal ke atas subjek dan hanya melibatkan data dan temuramah pesakit sahaja.

3. Segala rekod dan data subjek adalah SULIT dan hanya digunakan untuk tujuan kajian dan semua isu serta prosedur mengenai *data confidentiality* mesti dipatuhi. Kebenaran daripada Pengarah Hospital di mana kajian akan dijalankan mesti diperolehi terlebih dahulu sebelum kajian dijalankan. Puan perlu akur dan mematuhi keputusan tersebut.

4. Laporan tamat kajian dan sebarang penerbitan dari kajian ini hendaklah dikemukakan kepada Jawatankuasa Etika & Penyelidikan Perubatan selepas tamatnya kajian ini.

Sekian terima kasih.

BERKHIDMAT UNTUK NEGARA

Saya yang menurut perintah,

(DATO' DR CHANG KIAN MENG)
Pengerusi
Jawatankuasa Etika & Penyelidikan Perubatan
Kementerian Kesihatan Malaysia

Appendix I

Survey Questionnaire

Date

Dear Sir/Madam

A Survey on Information Technology (IT) System Implementation Success Factors in Malaysian Public Hospitals

Thank you for your involvement in this research. This survey is an independent research study to ascertain the critical success factors for a successful IT System Implementation in Malaysian Hospitals.

The objective of this survey is to identify the critical success factors for a successful IT System Implementation Project. This survey draws on your experiences and perceptions and is **not** an assessment of your skill or knowledge.

We request your kind assistance in this regard by **completing the attached survey and returning the completed form using the enclosed reply envelope.**

Findings from this survey will provide valuable information, which may influence how management plans, manages and implements an IT system. This survey will take approximately 20 minutes to complete. For further details of the survey please refer to the attached Information Sheet.

If you would like to discuss this survey, please do not hesitate to contact me at zainatul.abdullah@postgrad.curtin.edu.au or telephone +60133413532 (MY) or +61458883969 (AU).

Thank you for your kind cooperation and assistance.

Yours faithfully,

Assoc. Prof. Vanessa Chang
Supervisor
School of Information Systems
Curtin University of Technology
Perth, Australia

Zainatul Shima Abdullah
Doctoral Candidate
School of Information Systems
Curtin University of Technology
Perth, Australia

الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

Curtin University

General Instructions

1. Please answer the questions to the best of your knowledge. Most of the questions require your view or opinion measured on a five-point scale.

2. This survey will take approximately 20 minutes to complete.

3. Responses to all questions will be kept strictly confidential.

4. Please complete **ALL** sections.

Arahan Umum

1. *Sila jawab soalan-soalan mengikut pengetahuan terbaik anda. Kebanyakan soalan memerlukan pandangan atau pendapat anda yang diukur dengan skala lima mata.*

2. *Kaji selidik ini akan mengambil masa sekitar 20 minit untuk dilengkapkan.*

3. *Jawapan untuk semua soalan akan dirahsiakan.*

4. *Sila lengkapkan **SEMUA** bahagian.*

Definition of Key Terms

The following definitions will be used for the purpose of this survey:

1. **Information Technology (IT)** as defined by the Information Technology Association of America (ITAA) is "the study, design, development, application, implementation, support or management of computer based information systems, particularly software applications and computer hardware".

   In this survey, emphasis will be on IT system implementation.

2. **Information System (IS)** is any combination of IT and people's activities using the technology to support operations, management, and decision-making.

Definisi Istilah Utama

Definisi berikut akan digunakan untuk tujuan kajian ini:

1. ***Teknologi Maklumat (TM)*** *sebagaimana yang ditakrifkan oleh Information Technology Association of America (ITAA) ialah "kajian, rekabentuk, pembangunan, aplikasi, pelaksanaan, sokongan atau pengurusan sistem maklumat berasaskan komputer, khususnya perisian aplikasi dan perkakasan komputer".*

   Dalam kajian ini, penekanan adalah pada pelaksanaan sistem TM.

2. ***Sistem Maklumat (SM)*** *adalah kombinasi daripada TM dan aktiviti manusia yang menggunakan teknologi untuk menyokong operasi, pengurusan, dan pengambilan keputusan.*

SECTION A. DEMOGRAPHIC INFORMATION
SEKSYEN A. MAKLUMAT DEMOGRAFI

Please fill in the appropriate details or tick (√) the most appropriate box where applicable.
Sila isi butiran yang sesuai atau tandakan (√) pada kotak yang paling tepat.

1. Gender:
Jantina:
☐ Male *Lelaki*
☐ Female *Perempuan*

2. Age:
Umur:
☐ 24 and under *24 kebawah*
☐ 25-34
☐ 35-44
☐ 45-54
☐ 55 and above *55 keatas*

3. Name of hospital:
Nama hospital:
____

4. How long have you been involved in this project:
Berapa lama anda telah terlibat dalam projek ini:
☐ Less than 1 year *Kurang dari 1 tahun*
☐ 1-5 years *1-5 tahun*
☐ More than 5 years *Lebih dari 5 tahun*

5. How long have you been in your organization:
Berapa lama anda dalam organisasi anda:
☐ Less than 1 year *Kurang dari 1 tahun*
☐ 1-5 years *1-5 tahun*
☐ 6-10 years *6-10 tahun*
☐ More than 10 years *Lebih dari 10 tahun*

6. Years of technology-related experience:
Tahun pengalaman berkaitan teknologi:
☐ Less than 1 year *Kurang dari 1 tahun*
☐ 1-5 years *1-5 tahun*
☐ 6-10 years *6-10 tahun*
☐ More than 10 years *Lebih dari 10 tahun*

7. Number of employees in your organization:
Jumlah pekerja di dalam organisasi anda:
☐ Less than 100 *Kurang dari 100*
☐ 101-1000
☐ 1001-3000
☐ 3001-5000
☐ More than 5000 *Lebih dari 5000*

8. Your role in the project:
Peranan anda dalam projek:

- ☐ Project Champion *Juara Projek*
- ☐ Director *Pengarah*
- ☐ End-user *Pengguna*
- ☐ Key-user *Pengguna utama*
- ☐ Vendor *Vendor*
- ☐ Technical Advisor *Penasihat Teknikal*

9. How do you describe your involvement in this project implementation:
Bagaimana anda menjelaskan penglibatan anda dalam pelaksanaan projek:

- ☐ Directly *Secara langsung*
- ☐ Indirectly *Secara tidak langsung*
- ☐ Ministry level *Peringkat kementerian*
- ☐ Hospital level *Peringkat hospital*

10. Your job position in your organization:
Pekerjaan anda dalam organisasi:

- ☐ Managerial *Pengurusan*
- ☐ Non-managerial *Bukan pengurusan*
- ☐ Other. Please specify *Lain-lain. Sila nyatakan*

11. Your education level:
Tahap pendidikan anda:

- ☐ PhD
- ☐ Bachelors *Sarjana Muda*
- ☐ Masters *Sarjana*
- ☐ Diploma
- ☐ Other. Please specify *Lain-lain. Sila nyatakan*

12. If you are willing to participate in a follow up interview, please leave your contact number or email address.
Jika anda bersedia untuk turut serta dalam temuduga susulan, sila catitkan nombor telefon atau alamat e-mel anda.

13. If you would like to receive feedback regarding the research results, please leave your email address.
Jika anda ingin menerima maklum balas mengenai hasil penyelidikan, sila tinggalkan alamat e-mel anda.

SECTION B. CRITICAL SUCCESS FACTORS OF INFORMATION TECHNOLOGY (IT) SYSTEM IMPLEMENTATION
SEKSYEN B. FAKTOR KRITIKAL UNTUK KEJAYAAN PELAKSANAAN SISTEM TEKNOLOGI MAKLUMAT (TM)

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

	Note: IT System in this section refers to the Hospital Information System.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
	Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.	***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
1.	**Top Management Support and Project Championship** ***Sokongan Pengurusan Atasan dan Juara Projek***	**1**	**2**	**3**	**4**	**5**
	(Top management and champion support is crucial in IT system implementation.) *(Sokongan pengurusan atasan dan juara projek adalah sangat penting dalam pelaksanaan sistem TM.)*					
	a. The top management supports information technology implementation initiatives. *Pengurusan atasan menyokong inisiatif pelaksanaan teknologi maklumat.*	☐	☐	☐	☐	☐
	b. The top management demonstrates adequate commitment to the IT implementation. *Pengurusan atasan menunjukkan komitmen yang mencukupi untuk pelaksanaan TM.*	☐	☐	☐	☐	☐
	c. The top management has sufficient knowledge about the projects. *Pengurusan atasan mempunyai pengetahuan yang mencukupi tentang projek-projek.*	☐	☐	☐	☐	☐
	d. The top management has realistic expectation of the projects. *Pengurusan atasan mempunyai jangkaan yang realistik tentang projek.*	☐	☐	☐	☐	☐
	e. The IT implementation received explicit identification from top management as a critical priority. *Pelaksanaan TM menerima pengenalpastian eksplisit dari pengurusan atasan sebagai satu keutamaan kritikal.*	☐	☐	☐	☐	☐
	f. The top management provides necessary resources for IT implementation (e.g., manpower, training and incentives).	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

	Note: IT System in this section refers to the Hospital Information System.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.	***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
	Pengurusan atasan menyediakan sumber yang perlu untuk pelaksanaan TM (contoh: tenaga manusia, latihan dan insentif).					
	g. The IT project has a project champion. *Projek TM mempunyai juara projek.*	☐	☐	☐	☐	☐
	h. The top management and champion communicate with project team and users. *Pengurusan atasan dan juara projek berkomunikasi dengan pasukan projek dan para pengguna.*	☐	☐	☐	☐	☐
	i. The top management and champion provide related information with project team and users. *Pengurusan atasan dan juara projek memberikan maklumat yang berkaitan dengan pasukan projek dan para pengguna.*	☐	☐	☐	☐	☐
	j. The project champion has strong leadership. *Juara projek mempunyai ciri-ciri kepimpinan yang kuat.*	☐	☐	☐	☐	☐
	k. The project champion is empowered to make decisions (decision makers). *Juara projek diberi kuasa untuk membuat keputusan (pembuat keputusan).*	☐	☐	☐	☐	☐
	l. The project champion has business and technical competence. *Juara projek mempunyai kecekapan dari segi perniagaan dan teknikal.*	☐	☐	☐	☐	☐
2.	**Team Composition** ***Komposisi Pasukan***	**1**	**2**	**3**	**4**	**5**
	(IT projects require some combination of business and technical expertise.) *(Projek-projek TM memerlukan beberapa kombinasi perniagaan dan kepakaran teknikal.)*					
	a. The team selected for IT implementation had the best business knowledge. *Pasukan yang dipilih untuk pelaksanaan TM mempunyai pengetahuan perniagaan yang terbaik.*	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

Note: IT System in this section refers to the Hospital Information System.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.	***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
b. The team selected for IT implementation had the best technical knowledge. *Pasukan yang dipilih untuk pelaksanaan TM mempunyai pengetahuan teknikal yang terbaik.*	☐	☐	☐	☐	☐
c. The team selected for IT implementation had the best business and technical knowledge. *Pasukan yang dipilih untuk pelaksanaan TM mempunyai pengetahuan perniagaan dan teknikal yang terbaik.*	☐	☐	☐	☐	☐
d. A variety of cross-functional team was selected for the IT implementation. *Pelbagai ahli pasukan yang bersilang fungsi telah dipilih untuk pelaksanaan TM.*	☐	☐	☐	☐	☐
e. The project had sufficient team members. *Projek ini mempunyai ahli pasukan yang mencukupi.*	☐	☐	☐	☐	☐
f. The project has dedicated and committed team members. *Projek ini mempunyai ahli pasukan yang berdedikasi dan komited.*	☐	☐	☐	☐	☐
g. Those selected for the IT implementation were working on the project full-time as their only priority. *Mereka yang terpilih untuk pelaksanaan TM bekerja sepenuh masa didalam projek dan memberi keutamaan hanya kepada projek.*	☐	☐	☐	☐	☐
h. Those selected for the IT project were relocated together. *Mereka yang terpilih untuk projek TM telah ditempatkan bersama-sama.*	☐	☐	☐	☐	☐
i. Sufficient incentives or compensation were given to those selected for the IT project. *Insentif atau pampasan yang mencukupi telah diberikan kepada mereka yang dipilih untuk projek TM.*	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree. *Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.*						
Note: IT System in this section refers to the Hospital Information System.		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.		***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
3.	**Business Plan and Vision** ***Pelan Perniagaan dan Wawasan***	**1**	**2**	**3**	**4**	**5**
	(Business Plan and Vision is the project plan for the Information System implementation. A clear business or project plan will help the organization to maintain focus on business benefits and to guide ongoing organizational system implementation efforts.) *(Pelan perniagaan dan wawasan adalah pelan projek untuk pelaksanaan sistem maklumat. Pelan perniagaan atau pelan projek yang jelas akan membantu organisasi mengekalkan fokus pada manfaat perniagaan dan membimbing usaha pelaksanaan sistem organisasi secara berterusan.)*					
	a. The business or project plan and vision provide clear defined goals. *Pelan perniagaan atau pelan projek dan wawasan menyediakan sasaran yang jelas.*	☐	☐	☐	☐	☐
	b. The business or project plan and vision contain realistic objectives. *Pelan perniagaan atau pelan projek dan wawasan mengandungi objektif-objektif yang realistik.*	☐	☐	☐	☐	☐
	c. IT return on investment (ROI) is justified in the business plan. *Pulangan pelaburan TM (ROI) telah dijustifikasikan didalam pelan perniagaan.*	☐	☐	☐	☐	☐
	d. The business or project plan and vision provide benefits, resource allocation, costs, risks, and timeline. *Pelan perniagaan atau pelan projek dan wawasan menyediakan kemudahan, peruntukan sumber, kos-kos, risiko, dan had masa.*	☐	☐	☐	☐	☐
	e. The business or project plan and vision provide long-term vision that is integrated with company initiatives.	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

	Note: IT System in this section refers to the Hospital Information System.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
	Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.	***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
	Pelan perniagaan atau pelan projek dan wawasan menyediakan wawasan jangka panjang yang disepadukan dengan inisiatif-inisiatif syarikat.					
4.	**Project Management** ***Pengurusan Projek***	**1**	**2**	**3**	**4**	**5**
	(A competent project manager is necessary for successful IT system implementation. Project managers need to ensure that the scope of the project is clearly established, efficiently managed and effectively coordinated. Effective management of the project is essential for its success.) *(Seorang pengurus projek yang kompeten diperlukan untuk menjayakan pelaksanaan sistem TM. Pengurus projek perlu memastikan bahawa skop projek adalah jelas, diurus secara efisien dan dengan koordinasi yang berkesan. Pengurusan projek yang efektif adalah penting untuk kejayaan projek.)*					
	a. Task assignments, project scope were well-defined during the IT implementation. *Tugasan-tugasan kerja, skop projek adalah jelas semasa pelaksanaan TM.*	☐	☐	☐	☐	☐
	b. During the IT implementation, milestones were set with measurable results. *Semasa pelaksanaan TM, batu tanda (milestones) yang boleh diukur ditetapkan.*	☐	☐	☐	☐	☐
	c. There was commitment to promote and manage the IT implementation project. *Terdapat komitmen untuk mempromosi dan menguruskan pelaksanaan projek TM.*	☐	☐	☐	☐	☐
	d. Regular communication of expectation and challenges, education, training, and support were provided during the IT implementation. *Semasa pelaksanaan TM, komunikasi secara berterusan tentang jangkaan dan cabaran, pendidikan, latihan, dan sokongan telah disediakan.*	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

Note: IT System in this section refers to the Hospital Information System.		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.		***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
	e. Customization of the IT systems was well managed by the business team. *Pengubahsuaian khusus untuk sistem TM ini dikendalikan oleh pasukan perniagaan dengan baik.*	☐	☐	☐	☐	☐
	f. Coordination of the project was well administered. *Penyelarasan projek telah diurus dengan baik.*	☐	☐	☐	☐	☐
5.	**System Selection and Technical Implementation** ***Pemilihan Sistem dan Pelaksanaan Teknikal***	**1**	**2**	**3**	**4**	**5**
	(The selection of a system must be handled with utmost care and consideration. All system functionalities must be met by the system to prevent reconfiguration at every stage of the system implementation.) *(Pemilihan sistem mesti dikendalikan dengan penjagaan yang teliti dan pertimbangan yang amat baik. Semua fungsi sistem harus dipenuhi oleh sistem ini untuk mengelakkan konfigurasi yang berulang di setiap tahap pelaksanaan sistem ini.)*					
	a. The IT system has all the functionalities required. *Sistem TM ini mempunyai semua fungsi yang diperlukan.*	☐	☐	☐	☐	☐
	b. The IT system is linked with legacy (inherited) or existing systems. *Sistem TM ini diintegrasikan dengan sistem-sistem warisan atau sistem-sistem yang sedia ada.*	☐	☐	☐	☐	☐
	c. The IT system worked well with technology already in place. *Sistem TM ini berfungsi dengan baik dengan teknologi yang sedia ada.*	☐	☐	☐	☐	☐
	d. Vigorous and sophisticated testing has been conducted. *Ujian sistem yang intensif dan canggih telah dijalankan.*	☐	☐	☐	☐	☐
	e. There is sufficient support for integration and troubleshooting. *Terdapat sokongan yang mencukupi bagi integrasi dan penyelesaian masalah sistem.*	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

	Note: IT System in this section refers to the Hospital Information System.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
	Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.	***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
	f. The selection of the system requires minimum customization. *Pemilihan sistem ini memerlukan pengubahsuaian khusus yang minima.*	☐	☐	☐	☐	☐
	g. Long term infrastructure plans exists and are followed (e.g., data and network infrastructure). *Pelan infrastruktur jangka panjang wujud dan diikuti (contoh: infrastruktur data dan rangkaian).*	☐	☐	☐	☐	☐
	h. There is IS/IT planning to keep up with changing technology. *Terdapat perancangan SM/TM untuk menuruti perubahan teknologi.*	☐	☐	☐	☐	☐
6.	**Organization-wide Communication** ***Komunikasi Seluruh Organisasi***	**1**	**2**	**3**	**4**	**5**
	(Effective organization-wide communication and cooperation is important. Communication must be complete and open to ensure honesty.) *(Komunikasi organisasi yang luas dan kerjasama yang berkesan adalah penting. Komunikasi mestilah lengkap dan terbuka untuk memastikan kejujuran.)*					
	a. Team(s) involved in the IT project clearly understood the goals/objectives/purposes of the implementation. *Pasukan-pasukan yang terlibat dalam projek TM memahami matlamat-matlamat / objektif-objektif / tujuan-tujuan pelaksanaan.*	☐	☐	☐	☐	☐
	b. The project team was well-prepared to communicate effectively with the users. *Pasukan projek bersedia untuk berkomunikasi dengan berkesan dengan para pengguna.*	☐	☐	☐	☐	☐
	c. There were enough communication channels to inform the users of the stage of the IT project and help users resolve problems. *Terdapat saluran-saluran komunikasi yang mencukupi untuk memberitahu para pengguna tahap projek TM dan membantu pengguna menyelesaikan masalah.*	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree. *Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.*						
Note: IT System in this section refers to the Hospital Information System.		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.		***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
	d. There were enough evaluations to assess the workings of the IT systems. *Terdapat penilaian-penilaian yang mencukupi untuk menilai usaha-usaha sistem TM ini.*	☐	☐	☐	☐	☐
	e. Enough reviews were conducted to ensure continued IT end-user satisfaction. *Ulasan yang mencukupi telah dijalankan untuk memastikan kepuasan yang berterusan kepada pengguna TM.*	☐	☐	☐	☐	☐
7.	**Change Management and Culture Program** ***Perubahan Pengurusan dan Program Budaya***	**1**	**2**	**3**	**4**	**5**
	(Commitment to change and recognizing the need for change is very important in a system implementation project. Education and training should be provided and organizational culture should be considered to increase users' acceptance and participation in the change program.) *(Komitmen untuk berubah dan kesedaran akan perlunya perubahan sangat penting didalam sebuah projek pelaksanaan sistem. Pendidikan dan latihan harus disediakan dan budaya organisasi hendaklah dipertimbangkan untuk meningkatkan penerimaan pengguna dan penyertaan dalam program perubahan.)*					
	a. Employees are supportive, cooperative and helpful. *Warga kerja memberi sokongan, bekerjasama dan membantu.*	☐	☐	☐	☐	☐
	b. Employees are encouraged or rewarded by their superiors to express and exchange their opinions and ideas regarding work. *Pekerja-pekerja digalakkan atau diberi ganjaran oleh pihak-pihak atasan untuk mengutarakan dan bertukar pendapat serta idea berkaitan kerja.*	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

	Note: IT System in this section refers to the Hospital Information System.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
	Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.	***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
	c. There is willingness to collaborate across organizational units. *Wujudnya kesediaan untuk bekerja sama di seluruh unit organisasi.*	☐	☐	☐	☐	☐
	d. Adequate organizational resources are available to the employees (e.g., adequate user training and education). *Sumber organisasi yang mencukupi tersedia untuk para pekerja (contoh: latihan dan pendidikan yang cukup).*	☐	☐	☐	☐	☐
	e. Employees are encouraged to analyze mistakes that have been made and learn from them. *Pekerja-pekerja digalakkan untuk menganalisa kesilapan-kesilapan yang telah dibuat dan belajar daripada kesilapan tersebut.*	☐	☐	☐	☐	☐
	f. Opportunities are provided for individual development, other than formal training (e.g., work assignments and job rotation). *Peluang disediakan untuk pembangunan peribadi, selain daripada latihan formal (contoh: tugasan dan putaran kerja).*	☐	☐	☐	☐	☐
8.	**Are there any factors that you have experienced and are not listed above?** ***Apakah ada faktor-faktor lain yang anda alami dan tidak disenaraikan di atas?***					

SECTION C. SUCCESS MEASURES FOR IT SYSTEM IMPLEMENTATION
SEKSYEN C. MENGUKUR KEJAYAAN PELAKSANAAN SISTEM TM

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

	Note: IT System in this section refers to the Hospital Information System.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
	Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.	***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
1.	**System Quality** ***Kualiti Sistem***	**1**	**2**	**3**	**4**	**5**
	a. The IT system is easy to use. *Sistem TM ini senang digunakan.*	☐	☐	☐	☐	☐
	b. The IT system is user friendly. *Sistem TM ini adalah mesra pengguna.*	☐	☐	☐	☐	☐
	c. The IT system is easy to learn. *Sistem TM ini mudah dipelajari.*	☐	☐	☐	☐	☐
	d. I find it easy to get the system to do what I want it to do. *Saya rasa mudah untuk menjadikan sistem ini melakukan apa yang saya inginkan.*	☐	☐	☐	☐	☐
	e. The response and turnaround time of the IT system is acceptable. *Tempoh respon dan perputaran sistem TM ini boleh diterima.*	☐	☐	☐	☐	☐
	f. The IT system is reliable. *Sistem TM ini boleh dipercayai.*	☐	☐	☐	☐	☐
	g. The IT system is stable. *Sistem TM ini adalah stabil.*	☐	☐	☐	☐	☐
	h. The system is fast to recover from errors. *Sistem ini cepat untuk pulih dari masalah.*	☐	☐	☐	☐	☐
	i. The system is convenience to use. *Sistem ini mempunyai kemudahan untuk digunakan.*	☐	☐	☐	☐	☐
	j. The system can communicate sufficiently with other information systems. *Sistem ini boleh berkomunikasi secukupnya dengan sistem maklumat yang lain.*	☐	☐	☐	☐	☐
	k. I am satisfied with the IT system efficiency. *Saya berpuas hati dengan kecekapan sistem TM ini.*	☐	☐	☐	☐	☐
	l. I am satisfied with the IT system effectiveness. *Saya berpuas hati dengan keberkesanan sistem TM ini.*	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

	Note: IT System in this section refers to the Hospital Information System.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
	Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.	***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
2.	**Information Quality** ***Kualiti Maklumat***	**1**	**2**	**3**	**4**	**5**
	a. The information output is presented in a useful format. *Output maklumat dibentangkan dalam format yang berguna.*	☐	☐	☐	☐	☐
	b. The information provided seem to be the precise information I need. *Maklumat yang diberikan adalah tepat seperti yang saya perlukan.*	☐	☐	☐	☐	☐
	c. The information provided is accurate and reliable. *Maklumat yang diberikan adalah tepat dan boleh dipercayai*	☐	☐	☐	☐	☐
	d. I am satisfied with the accuracy of the system. *Saya berpuas hati dengan ketepatan sistem ini.*	☐	☐	☐	☐	☐
	e. The information provided is relevant and useful for my work. *Maklumat yang diberikan adalah relevan dan berguna untuk pekerjaan saya.*	☐	☐	☐	☐	☐
	f. The information provided is clear and understandable. *Maklumat yang diberikan adalah jelas dan difahami.*	☐	☐	☐	☐	☐
	g. The information provided is complete. *Maklumat yang diberikan adalah lengkap.*	☐	☐	☐	☐	☐
	h. The information provided is sufficient. *Maklumat yang disediakan adalah mencukupi.*	☐	☐	☐	☐	☐
	i. The information provided is consistent. *Maklumat yang diberikan adalah konsisten.*	☐	☐	☐	☐	☐
	j. The information provided is up-to-date information. *Maklumat yang diberikan adalah maklumat terkini.*	☐	☐	☐	☐	☐
	k. The information provided is timely. *Maklumat yang diberikan adalah tepat pada masanya.*	☐	☐	☐	☐	☐
	l. The IT system meets my information process needs. *Sistem TM ini memenuhi keperluan maklumat saya.*	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

	Note: IT System in this section refers to the Hospital Information System.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.	*Sangat Tidak Setuju*	*Tidak Setuju*	*Neutral*	*Setuju*	*Sangat Setuju*
3.	**Service Quality** *Kualiti Perkhidmatan*	**1**	**2**	**3**	**4**	**5**
	The ICT unit / division employees: *Unit TM / pekerja bahagian:*	☐	☐	☐	☐	☐
	a. Provide prompt service to users. *Menyediakan perkhidmatan yang segera kepada pengguna.*	☐	☐	☐	☐	☐
	b. Have the knowledge to do their jobs well. *Mempunyai pengetahuan untuk melakukan pekerjaan mereka dengan baik.*	☐	☐	☐	☐	☐
	c. Are always willing to help. *Sentiasa bersedia membantu.*	☐	☐	☐	☐	☐
	d. Deliver when they promise to do something. *Memenuhi janji apabila berjanji untuk melakukan sesuatu.*	☐	☐	☐	☐	☐
	e. Show sincere interest in solving problems encountered by myself or others in my work group. *Menunjukkan minat yang tulus dalam menyelesaikan masalah yang dihadapi saya atau orang lain dalam kumpulan kerja saya.*	☐	☐	☐	☐	☐
	f. Understand my needs and those of my work group. *Memahami keperluan saya dan ahli kumpulan kerja saya.*	☐	☐	☐	☐	☐
	g. Provide me individual attention. *Memberikan saya perhatian individu.*	☐	☐	☐	☐	☐
	h. Provide follow-up service to users. *Memberikan perkhidmatan lanjut an kepada pengguna.*	☐	☐	☐	☐	☐
	i. Provide assurance to solve problems. *Memberikan jaminan untuk menyelesaikan masalah.*	☐	☐	☐	☐	☐
	j. Are consistently courteous with users. *Sentiasa bersopan santun dengan para pengguna.*	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

Note: IT System in this section refers to the Hospital Information System.		**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.		***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
4.	**Individual Impact** ***Kesan individu***	**1**	**2**	**3**	**4**	**5**
	a. Using the system in my job enables me to accomplish tasks faster. *Menggunakan sistem ini dalam pekerjaan saya membolehkan saya untuk menyelesaikan tugas lebih cepat.*	☐	☐	☐	☐	☐
	b. Using the system saves time. *Menggunakan sistem ini menjimatkan masa.*	☐	☐	☐	☐	☐
	c. Using the system improves my job performance. *Menggunakan sistem ini meningkatkan prestasi kerja saya.*	☐	☐	☐	☐	☐
	d. Using the system in my job increases my productivity. *Menggunakan sistem ini meningkatkan produktiviti kerja saya.*	☐	☐	☐	☐	☐
	e. Using the system enhances my effectiveness in my job. *Menggunakan sistem ini menambahkan keberkesanan kerja saya.*	☐	☐	☐	☐	☐
	f. Using the system makes it easier to complete my job. *Menggunakan sistem ini memudahkan saya menyelesaikan pekerjaan saya.*	☐	☐	☐	☐	☐
	g. I find the system is useful in my job. *Saya mendapati sistem ini berguna dalam pekerjaan saya.*	☐	☐	☐	☐	☐
	h. Using the system enhances my awareness and recall of job related information. *Menggunakan sistem ini meningkatkan kesedaran saya dan mengingatkan kembali maklumat yang berkaitan.*	☐	☐	☐	☐	☐
	i. I learn a lot through the presence of the system. *Saya banyak belajar dengan adanya sistem ini.*	☐	☐	☐	☐	☐
	j. Overall, I am satisfied with the IT system. *Secara keseluruhan, saya berpuas hati dengan sistem TM ini.*	☐	☐	☐	☐	☐

Please indicate the extent to which you agree or disagree with each of the following statements by marking (√) against the appropriate scale shown. Range is 1 – Strongly Disagree to 5 – Strongly Agree.
Sila nyatakan sama ada anda bersetuju atau tidak bersetuju dengan setiap kenyataan-kenyataan berikut dengan menandakan (√) pada skala yang sesuai. Skala antara 1 – Sangat Tidak Setuju hingga 5 – Sangat Setuju.

Note: IT System in this section refers to the Hospital Information System.		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Nota: Sistem TM dalam seksyen ini merujuk kepada Hospital Information System.		***Sangat Tidak Setuju***	***Tidak Setuju***	***Neutral***	***Setuju***	***Sangat Setuju***
5.	**Organizational Impact** ***Kesan Organisasi***	**1**	**2**	**3**	**4**	**5**
	a. Capacity planning, cost estimation and inventory control have improved. *Perancangan kapasiti, anggaran perbelanjaan dan kawalan inventori telah meningkat.*	☐	☐	☐	☐	☐
	b. The system has resulted in overall productivity improvement. *Sistem ini telah menghasilkan peningkatan produktiviti secara keseluruhan.*	☐	☐	☐	☐	☐
	c. The system has resulted in an increased capacity to manage a growing volume of activity. *Sistem ini telah menghasilkan peningkatan kapasiti dalam menguruskan penambahan jumlah aktiviti.*	☐	☐	☐	☐	☐
	d. The system has resulted in improved business process. *Sistem ini telah menghasilkan peningkatan proses perniagaan.*	☐	☐	☐	☐	☐
	e. There is a reduction in informal systems for hospitals. *Terdapat pengurangan sistem tidak rasmi di hospital-hospital.*	☐	☐	☐	☐	☐
	f. There is a reduction of operating cost. *Terdapat pengurangan kos operasi.*	☐	☐	☐	☐	☐
	g. Cooperation between various departments within the organization has improved (e.g., finance, human resource, and operations). *Kerjasama antara jabatan dalam organisasi telah meningkat (contoh: kewangan, sumber manusia, dan operasi).*	☐	☐	☐	☐	☐
	h. Employee job satisfaction and morale has improved. *Kepuasan kerja dan moral pekerja telah meningkat.*	☐	☐	☐	☐	☐
	i. The system improves communication efficiency. *Sistem ini meningkatkan kecekapan komunikasi.*	☐	☐	☐	☐	☐
	j. The system improves the quality of service. *Sistem ini meningkatkan kualiti perkhidmatan.*	☐	☐	☐	☐	☐

Appendix J

Descriptive Statistics for All Indicators

Item Code	N	Minimum	Maximum	Mean	Std. Deviation
TM1	213	2	5	4.03	.713
TM2	213	1	5	3.85	.772
TM3	213	1	5	3.61	.798
TM4	213	1	5	3.64	.743
TM5	213	1	5	3.66	.700
TM6	213	1	5	3.63	.900
TM7	213	1	5	3.47	.810
TM8	213	1	5	3.61	.780
TM9	213	1	5	3.59	.787
TM10	213	1	5	3.47	.827
TM11	213	1	5	3.44	.748
TM12	213	1	5	3.50	.822
TC1	213	1	5	3.53	.838
TC2	213	1	5	3.56	.842
TC3	213	1	5	3.46	.827
TC4	213	1	5	3.64	.749
TC5	213	1	5	3.45	.837
TC6	213	1	5	3.61	.780
TC7	213	1	5	3.52	.844
TC8	213	1	5	3.51	.787
TC9	213	1	5	3.28	.822
BP1	213	1	5	3.52	.704
BP2	213	1	5	3.47	.711
BP3	213	1	5	3.35	.675
BP4	213	1	5	3.44	.735
BP5	213	1	5	3.43	.740
PM1	213	1	5	3.55	.791
PM2	213	1	5	3.49	.810
PM3	213	1	5	3.57	.701
PM4	213	1	5	3.66	.759
PM5	213	1	5	3.38	.819
PM6	213	1	5	3.48	.822
SS1	213	1	5	3.34	.889
SS2	213	1	5	3.42	.806
SS3	213	1	5	3.44	.802
SS4	213	1	5	3.34	.830
SS5	213	1	5	3.45	.843
SS6	213	1	5	3.32	.791
SS7	213	1	5	3.46	.809
SS8	213	1	5	3.43	.783
EC1	213	1	5	3.54	.676
EC2	213	1	5	3.57	.741
EC3	213	1	5	3.54	.786
EC4	213	1	5	3.37	.781
EC5	213	1	5	3.35	.826

Item Code	N	Minimum	Maximum	Mean	Std. Deviation
CM1	213	1	5	3.70	.683
CM2	213	1	5	3.48	.810
CM3	213	1	5	3.62	.754
CM4	213	1	5	3.48	.810
CM5	213	1	5	3.55	.809
CM6	213	1	5	3.53	.798
SQ1	213	1	5	3.70	.903
SQ2	213	1	5	3.57	.952
SQ3	213	1	5	3.62	.885
SQ4	213	1	5	3.49	.950
SQ5	213	1	5	3.47	.872
SQ6	213	1	5	3.56	.881
SQ7	213	1	5	3.50	.850
SQ8	213	1	5	3.42	.901
SQ9	213	1	5	3.59	.805
SQ10	213	1	5	3.45	.860
SQ11	213	1	5	3.48	.888
SQ12	213	1	5	3.52	.866
IQ1	213	1	5	3.56	.785
IQ2	213	1	5	3.54	.810
IQ3	213	1	5	3.56	.808
IQ4	213	1	5	3.51	.787
IQ5	213	1	5	3.67	.731
IQ6	213	1	5	3.64	.736
IQ7	213	1	5	3.48	.822
IQ8	213	1	5	3.51	.822
IQ9	213	1	5	3.61	.809
IQ10	213	1	5	3.64	.809
IQ11	213	1	5	3.57	.813
IQ12	213	1	5	3.51	.833
SvQ1	213	1	5	3.74	.756
SvQ2	213	1	5	3.65	.778
SvQ3	213	1	5	3.82	.700
SvQ4	213	1	5	3.63	.781
SvQ5	213	1	5	3.72	.743
SvQ6	213	1	5	3.67	.749
SvQ7	213	1	5	3.59	.764
SvQ8	213	1	5	3.67	.736
SvQ9	213	1	5	3.66	.776
SvQ10	213	2	5	3.82	.641
II1	213	1	5	3.71	.840
II2	213	1	5	3.72	.833
II3	213	1	5	3.75	.802
II4	213	1	5	3.73	.796
II5	213	1	5	3.73	.802
II6	213	1	5	3.72	.827
II7	213	1	5	3.78	.785
II8	213	1	5	3.76	.775
II9	213	1	5	3.81	.785
II10	213	1	5	3.70	.865

Item Code	N	Minimum	Maximum	Mean	Std. Deviation
OI1	213	1	5	3.57	.790
OI2	213	1	5	3.59	.751
OI3	213	1	5	3.60	.756
OI4	213	1	5	3.56	.702
OI5	213	1	5	3.56	.702
OI6	213	1	5	3.29	.782
OI7	213	1	5	3.55	.748
OI8	213	1	5	3.48	.781
OI9	213	1	5	3.58	.746
OI10	213	1	5	3.68	.721
Valid N (listwise)	213				

Appendix K

Measuring Item Code and Description

Table K.1: Critical Success Factors Identified for HIS Implementation

Item Code	Item Description
Top Management Support and Project Championship	
TM1	The top management supports information technology implementation initiatives.
TM2	The top management demonstrates adequate commitment to the IT implementation.
TM3	The top management has sufficient knowledge about the projects.
TM4	The top management has realistic expectation of the projects.
TM5	The IT implementation received explicit identification from top management as a critical priority.
TM6	The top management provides necessary resources for IT implementation (e.g., manpower, training and incentives).
TM7	The IT project has a project champion.
TM8	The top management and champion communicate with project team and users.
TM9	The top management and champion provide related information with project team and users.
TM10	The project champion has strong leadership.
TM11	The project champion is empowered to make decisions (decision makers).
TM12	The project champion has business and technical competence.
Team Composition	
TC1	The team selected for IT implementation had the best business knowledge.
TC2	The team selected for IT implementation had the best technical knowledge.
TC3	The team selected for IT implementation had the best business and technical knowledge.
TC4	A variety of cross-functional team was selected for the IT implementation.
TC5	The project had sufficient team members.
TC6	The project has dedicated and committed team members.
TC7	Those selected for the IT implementation were working on the project full-time as their only priority.
TC8	Those selected for the IT project were relocated together.
TC9	Sufficient incentives or compensation were given to those selected for the IT project.
Business Plan and Vision	
BP1	The business or project plan and vision provide clear defined goals.
BP2	The business or project plan and vision contain realistic objectives.
BP3	IT return on investment (ROI) is justified in the business plan.
BP4	The business or project plan and vision provide benefits, resource allocation, costs, risks, and timeline.
BP5	The business or project plan and vision provide long-term vision that is integrated with company initiatives.
Project Management	
PM1	Task assignments, project scope were well-defined during the IT implementation.
PM2	During the IT implementation, milestones were set with measurable results.
PM3	There was commitment to promote and manage the IT implementation project.
PM4	Regular communication of expectation and challenges, education, training, and support were provided during the IT implementation.
PM5	Customization of the IT systems was well managed by the business team.
PM6	Coordination of the project was well administered.

Item Code	Item Description
System Selection and Technical Implementation	
SS1	The IT system has all the functionalities required.
SS2	The IT system is linked with legacy (inherited) or existing systems.
SS3	The IT system worked well with technology already in place.
SS4	Vigorous and sophisticated testing has been conducted.
SS5	There is sufficient support for integration and troubleshooting.
SS6	The selection of the system requires minimum customization.
SS7	Long term infrastructure plans exists and are followed (e.g., data and network infrastructure).
SS8	There is IS/IT planning to keep up with changing technology.
Enterprise-wide Communication	
EC1	Team(s) involved in the IT project clearly understood the goals/objectives/purposes of the implementation.
EC2	The project team was well-prepared to communicate effectively with the users.
EC3	There were enough communication channels to inform the users of the stage of the IT project and help users resolve problems.
EC4	There were enough evaluations to assess the workings of the IT systems.
EC5	Enough reviews were conducted to ensure continued IT end-user satisfaction.
Change Management and Culture Program	
CM1	Employees are supportive, cooperative and helpful.
CM2	Employees are encouraged or rewarded by their superiors to express and exchange their opinions and ideas regarding work.
CM3	There is willingness to collaborate across organizational units.
CM4	Adequate organizational resources are available to the employees (e.g., adequate user training and education).
CM5	Employees are encouraged to analyze mistakes that have been made and learn from them.
CM6	Opportunities are provided for individual development, other than formal training (e.g., work assignments and job rotation).

Table K.2: Success Measures for HIS Implementation

Item Code	Item Description
System Quality	
SQ1	The IT system is easy to use.
SQ2	The IT system is user friendly.
SQ3	The IT system is easy to learn.
SQ4	I find it easy to get the system to do what I want it to do.
SQ5	The response and turnaround time of the IT system is acceptable.
SQ6	The IT system is reliable.
SQ7	The IT system is stable.
SQ8	The system is fast to recover from errors.
SQ9	The system is convenience to use.
SQ10	The system can communicate sufficiently with other information systems.
SQ11	I am satisfied with the IT system efficiency.
SQ12	I am satisfied with the IT system effectiveness.
Information Quality	
IQ1	The information output is presented in a useful format.
IQ2	The information provided seem to be the precise information I need.
IQ3	The information provided is accurate and reliable.
IQ4	I am satisfied with the accuracy of the system.
IQ5	The information provided is relevant and useful for my work.
IQ6	The information provided is clear and understandable.
IQ7	The information provided is complete.
IQ8	The information provided is sufficient.
IQ9	The information provided is consistent.
IQ10	The information provided is up-to-date information.
IQ11	The information provided is timely.
IQ12	The IT system meets my information process needs.
Service Quality	
SvQ1	Provide prompt service to users.
SvQ2	Have the knowledge to do their jobs well.
SvQ3	Are always willing to help.
SvQ4	Deliver when they promise to do something.
SvQ5	Show sincere interest in solving problems encountered by myself or others in my work group.
SvQ6	Understand my needs and those of my work group.
SvQ7	Provide me individual attention.
SvQ8	Provide follow-up service to users.
SvQ9	Provide assurance to solve problems.
SvQ10	Are consistently courteous with users.
Individual Impact	
II1	Using the system in my job enables me to accomplish tasks faster.
II2	Using the system saves time.
II3	Using the system improves my job performance.
II4	Using the system in my job increases my productivity.
II5	Using the system enhances my effectiveness in my job.
II6	Using the system makes it easier to complete my job.
II7	I find the system is useful in my job.
II8	Using the system enhances my awareness and recall of job related information.
II9	I learn a lot through the presence of the system.
II10	Overall, I am satisfied with the IT system.

Item Code	Item Description
Organization Impact	
OI1	Capacity planning, cost estimation and inventory control have improved.
OI2	The system has resulted in overall productivity improvement.
OI3	The system has resulted in an increased capacity to manage a growing volume of activity.
OI4	The system has resulted in improved business process.
OI5	There is a reduction in informal systems for hospitals.
OI6	There is a reduction of operating cost.
OI7	Cooperation between various departments within the organization has improved (e.g., finance, human resource, and operations).
OI8	Employee job satisfaction and morale has improved.
OI9	The system improves communication efficiency.
OI10	The system improves the quality of service.

Appendix L

PLS Bootstrap Output for Measurement Model Analysis

Output results with Construct Level sign change preprocessing:
Bootstrap raw data generated for Prof Mohammed Quaddus, PhD
Number of cases in full model: 213
Number of cases per sample: 213
Number of samples generated: 100
Number of good samples: 100

Outer Model Loadings:

	Original sample estimate	Mean of subsamples	Standard error	T-Statistic
TopMgt :				
(Composite Reliability =	0.933 , AVE =	0.738)		
TM4	0.8151	0.8154	0.0265	30.7209
TM6	0.8391	0.8404	0.0213	39.3677
TM8	0.8907	0.8895	0.0199	44.7684
TM9	0.8944	0.8941	0.0178	50.3293
TM10	0.8521	0.8564	0.0265	32.1912
BussPlan:				
(Composite Reliability =	0.938 , AVE =	0.750)		
BP1	0.8226	0.8292	0.0279	29.5324
BP2	0.8856	0.8868	0.0173	51.1413
BP3	0.8394	0.8394	0.0331	25.3251
BP4	0.8831	0.8830	0.0226	39.0341
BP5	0.8977	0.9000	0.0192	46.6393
EntComm :				
(Composite Reliability =	0.940 , AVE =	0.758)		
EC1	0.8620	0.8638	0.0249	34.6603
EC2	0.8787	0.8800	0.0245	35.8146
EC3	0.8646	0.8648	0.0267	32.3429
EC4	0.9060	0.9083	0.0172	52.6912
EC5	0.8418	0.8462	0.0272	30.9884
ProjMgt :				
(Composite Reliability =	0.941 , AVE =	0.801)		
PM3	0.8760	0.8797	0.0249	35.1613
PM4	0.8769	0.8806	0.0210	41.8013
PM5	0.9058	0.9062	0.0154	58.7656
PM6	0.9197	0.9198	0.0116	79.5671

TeamComp:
(Composite Reliability = 0.928 , AVE = 0.762)

TC2	0.8951	0.8984	0.0143	62.6233
TC3	0.8876	0.8903	0.0181	48.9764
TC6	0.8723	0.8745	0.0210	41.5359
TC7	0.8364	0.8437	0.0244	34.3265

ChgMgt :
(Composite Reliability = 0.925 , AVE = 0.755)

CM3	0.8574	0.8630	0.0241	35.6375
CM4	0.8867	0.8878	0.0224	39.5852
CM5	0.8676	0.8691	0.0310	27.9817
CM6	0.8647	0.8653	0.0279	31.0225

SysSel :
(Composite Reliability = 0.938 , AVE = 0.750)

SS3	0.8421	0.8379	0.0271	31.0945
SS4	0.8699	0.8703	0.0223	39.0688
SS5	0.8850	0.8796	0.0188	47.1214
SS7	0.8817	0.8801	0.0211	41.7702
SS8	0.8515	0.8492	0.0247	34.4683

First and Second Order Factors Computed using Latent Variable Values

SysQ :
(Composite Reliability = 1.000 , AVE = 1.000)

SQlv	1.0000	1.0000	0.0000	0.0000

InfoQ :
(Composite Reliability = 1.000 , AVE = 1.000)

IQlv	1.0000	1.0000	0.0000	0.0000

ServQ :
(Composite Reliability = 1.000 , AVE = 1.000)

SvQlv	1.0000	1.0000	0.0000	0.0000

IndImp :
(Composite Reliability = 1.000 , AVE = 1.000)

IIlv	1.0000	1.0000	0.0000	0.0000

OrgImp :
(Composite Reliability = 1.000 , AVE = 1.000)

OIlv	1.0000	1.0000	0.0000	0.0000

HISSucc :
(Composite Reliability = 0.954 , AVE = 0.804)

SQlv	0.8964	0.8989	0.0152	58.9403
IQlv	0.9104	0.9102	0.0182	49.9635
SvQlv	0.8880	0.8937	0.0176	50.5571
IIlv	0.8949	0.8967	0.0208	43.1061
OIlv	0.8945	0.8971	0.0165	54.1182

First and Second Order Factors Computed using Survey Data Values

SysQ :
(Composite Reliability = 0.961 , AVE = 0.754)

SQ1	0.8725	0.8737	0.0216	40.3686
SQ2	0.8867	0.8815	0.0217	40.9121
SQ3	0.8979	0.8952	0.0195	46.1595
SQ4	0.8908	0.8885	0.0179	49.8818
SQ5	0.8410	0.8349	0.0304	27.6553
SQ6	0.8360	0.8294	0.0273	30.5673
SQ7	0.8218	0.8269	0.0261	31.4773
SQ9	0.8977	0.8961	0.0149	60.0619

InfoQ :
(Composite Reliability = 0.974 , AVE = 0.774)

IQ1	0.8573	0.8596	0.0210	40.7537
IQ2	0.8628	0.8676	0.0226	38.0963
IQ3	0.8999	0.9014	0.0162	55.3954
IQ4	0.8861	0.8835	0.0208	42.6550
IQ5	0.8673	0.8627	0.0298	29.1310
IQ6	0.8816	0.8800	0.0227	38.8833
IQ7	0.8788	0.8813	0.0194	45.3340
IQ8	0.8897	0.8929	0.0170	52.2340
IQ9	0.8718	0.8768	0.0219	39.7728
IQ10	0.8851	0.8863	0.0193	45.8108
IQ11	0.8985	0.9018	0.0168	53.5710

ServQ :
(Composite Reliability = 0.966 , AVE = 0.740)

SvQ1	0.8705	0.8712	0.0215	40.4710
SvQ2	0.8788	0.8793	0.0240	36.6858
SvQ3	0.8756	0.8720	0.0255	34.3619
SvQ4	0.8605	0.8599	0.0261	33.0230
SvQ5	0.8650	0.8613	0.0266	32.5497
SvQ6	0.8462	0.8447	0.0294	28.8248
SvQ7	0.8415	0.8340	0.0260	32.3394
SvQ8	0.8730	0.8712	0.0280	31.2278
SvQ9	0.8709	0.8706	0.0240	36.3276
SvQ10	0.8207	0.8211	0.0344	23.8821

IndImp :
(Composite Reliability = 0.977 , AVE = 0.825)

II1	0.9096	0.9036	0.0194	46.7809
II2	0.9267	0.9258	0.0159	58.1963
II3	0.9285	0.9244	0.0150	61.8516
II4	0.9384	0.9355	0.0142	66.2739
II5	0.9380	0.9359	0.0135	69.3566
II6	0.9333	0.9288	0.0125	74.5733
II7	0.8902	0.8855	0.0286	31.1646
II8	0.8587	0.8579	0.0310	27.6640
II9	0.8453	0.8495	0.0333	25.3713

OrgImp :
(Composite Reliability = 0.958 , AVE = 0.766)

OI2	0.9023	0.8981	0.0162	55.7186
OI3	0.8898	0.8866	0.0189	47.1203
OI4	0.8697	0.8704	0.0261	33.2647
OI7	0.8235	0.8219	0.0362	22.7391
OI8	0.8874	0.8853	0.0190	46.7226
OI9	0.8712	0.8667	0.0285	30.5647
OI10	0.8815	0.8784	0.0220	40.0201

HISSucc :
(Composite Reliability = 0.987 , AVE = 0.622)

SQ1	0.7564	0.7536	0.0367	20.6151
SQ2	0.7530	0.7474	0.0367	20.5456
SQ3	0.7944	0.7933	0.0304	26.0926
SQ4	0.7809	0.7834	0.0315	24.7718
SQ5	0.7744	0.7748	0.0343	22.5967
SQ6	0.7865	0.7818	0.0303	25.9495
SQ7	0.7473	0.7541	0.0313	23.8929
SQ9	0.8131	0.8125	0.0234	34.7633
IQ1	0.8256	0.8256	0.0286	28.8699
IQ2	0.8135	0.8247	0.0252	32.2238
IQ3	0.8121	0.8214	0.0277	29.3612
IQ4	0.7972	0.7991	0.0338	23.5807
IQ5	0.8059	0.8077	0.0361	22.3338
IQ6	0.8220	0.8240	0.0303	27.1734
IQ7	0.7790	0.7824	0.0305	25.5114
IQ8	0.8080	0.8190	0.0266	30.3614
IQ9	0.7900	0.7913	0.0301	26.2190
IQ10	0.8213	0.8231	0.0260	31.6430
IQ11	0.8206	0.8210	0.0292	28.1208
SvQ1	0.7995	0.7990	0.0366	21.8628
SvQ2	0.8554	0.8524	0.0239	35.7183
SvQ3	0.7688	0.7664	0.0433	17.7533
SvQ4	0.7388	0.7395	0.0432	17.1007
SvQ5	0.6993	0.6947	0.0499	14.0173
SvQ6	0.8158	0.8164	0.0314	25.9636
SvQ7	0.7135	0.7034	0.0488	14.6180
SvQ8	0.7968	0.7974	0.0367	21.7384
SvQ9	0.7791	0.7846	0.0414	18.8169
SvQ10	0.6888	0.6946	0.0605	11.3928
II1	0.8081	0.7986	0.0389	20.7846
II2	0.8258	0.8228	0.0324	25.4829
II3	0.8240	0.8192	0.0345	23.8820
II4	0.8278	0.8252	0.0352	23.4923
II5	0.8348	0.8333	0.0304	27.4726
II6	0.8389	0.8337	0.0301	27.8919
II7	0.8118	0.8065	0.0323	25.1268
II8	0.7453	0.7393	0.0471	15.8336
II9	0.7794	0.7810	0.0407	19.1573
OI2	0.8106	0.8032	0.0266	30.4766
OI3	0.7828	0.7762	0.0326	24.0460

OI4	0.7581	0.7576	0.0390	19.4494
OI7	0.7540	0.7531	0.0351	21.4637
OI8	0.7767	0.7750	0.0322	24.1036
OI9	0.7516	0.7492	0.0406	18.4943
OI10	0.7658	0.7668	0.0341	22.4698

Appendix M

PLS Bootstrap Output for Structural Model Analysis

Path Coefficients Table (Original Sample Estimate):

	TopMgt	BussPlan	EntComm	ProjMgt	TeamComp	ChgMgt	SysSel	SysQ	InfoQ	ServQ	IndImp	OrgImp	HISSucc
TopMgt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BussPlan	0.6770	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EntComm	0.6800	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ProjMgt	0.2560	0.2560	0.4460	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TeamComp	0.0000	0.0000	0.3290	0.5320	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ChgMgt	0.0000	0.0000	0.5640	0.2930	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SysSel	0.0000	0.0000	0.5160	0.4060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SysQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8960
InfoQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9100
ServQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8880
IndImp	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8950
OrgImp	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8950
HISSucc	-0.0140	0.0850	0.2060	0.0210	0.1350	0.1570	0.2980	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Path Coefficients Table (Mean of Subsamples):

	TopMgt	BussPlan	EntComm	ProjMgt	TeamComp	ChgMgt	SysSel	SysQ	InfoQ	ServQ	IndImp	OrgImp	HISSucc
TopMgt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BussPlan	0.6819	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EntComm	0.6894	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ProjMgt	0.2537	0.2515	0.4536	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TeamComp	0.0000	0.0000	0.3380	0.5289	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ChgMgt	0.0000	0.0000	0.5593	0.2988	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SysSel	0.0000	0.0000	0.5328	0.3943	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SysQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8989
InfoQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9101
ServQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8937
IndImp	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8967
OrgImp	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8971
HISSucc	-0.0082	0.0872	0.2021	0.0312	0.1360	0.1407	0.2966	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Path Coefficients Table (Standard Error):

	TopMgt	BussPlan	EntComm	ProjMgt	TeamComp	ChgMgt	SysSel	SysQ	InfoQ	ServQ	IndImp	OrgImp	HISSucc
TopMgt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BussPlan	0.0467	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EntComm	0.0431	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ProjMgt	0.0489	0.0700	0.0777	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TeamComp	0.0000	0.0000	0.0695	0.0699	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ChgMgt	0.0000	0.0000	0.0825	0.0837	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SysSel	0.0000	0.0000	0.0690	0.0686	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SysQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0152
InfoQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0182
ServQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0175
IndImp	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0208
OrgImp	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0166
HISSucc	0.0642	0.0832	0.0994	0.0838	0.0641	0.0847	0.0902	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Path Coefficients Table (T-Statistic)

	TopMgt	BussPlan	EntComm	ProjMgt	TeamComp	ChgMgt	SysSel	SysQ	InfoQ	ServQ	IndImp	OrgImp	HISSucc
TopMgt	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BussPlan	14.5111	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EntComm	15.7696	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ProjMgt	5.2387	3.6546	5.7382	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TeamComp	0.0000	0.0000	4.7333	7.6064	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ChgMgt	0.0000	0.0000	6.8373	3.5001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SysSel	0.0000	0.0000	7.4784	5.9194	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SysQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	58.9219
InfoQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	49.9731
ServQ	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	50.6813
IndImp	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	43.1074
OrgImp	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	53.9540
HISSucc	0.2182	1.0216	2.0720	0.2507	2.1074	1.8528	3.3028	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix N

PLS Graphic Output